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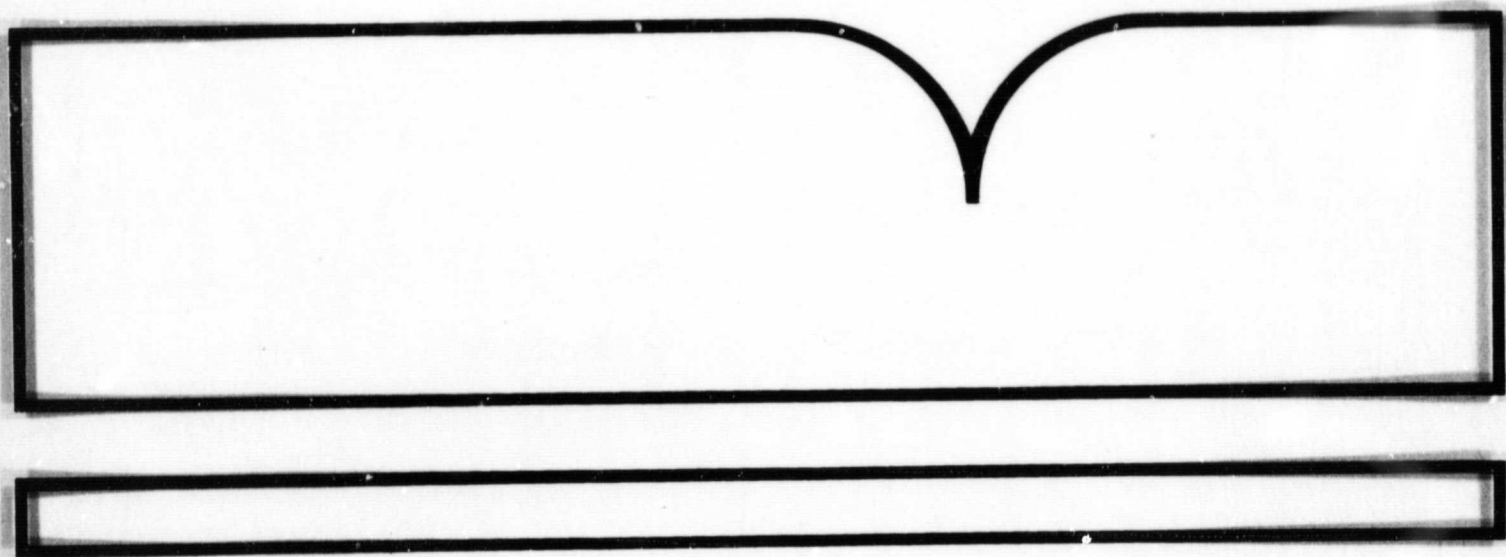
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Highlights of Contractor Initiatives in Quality
Enhancement and Productivity Improvement

(U.S.) National Aeronautics and Space
Administration, Washington, DC

Jul 86



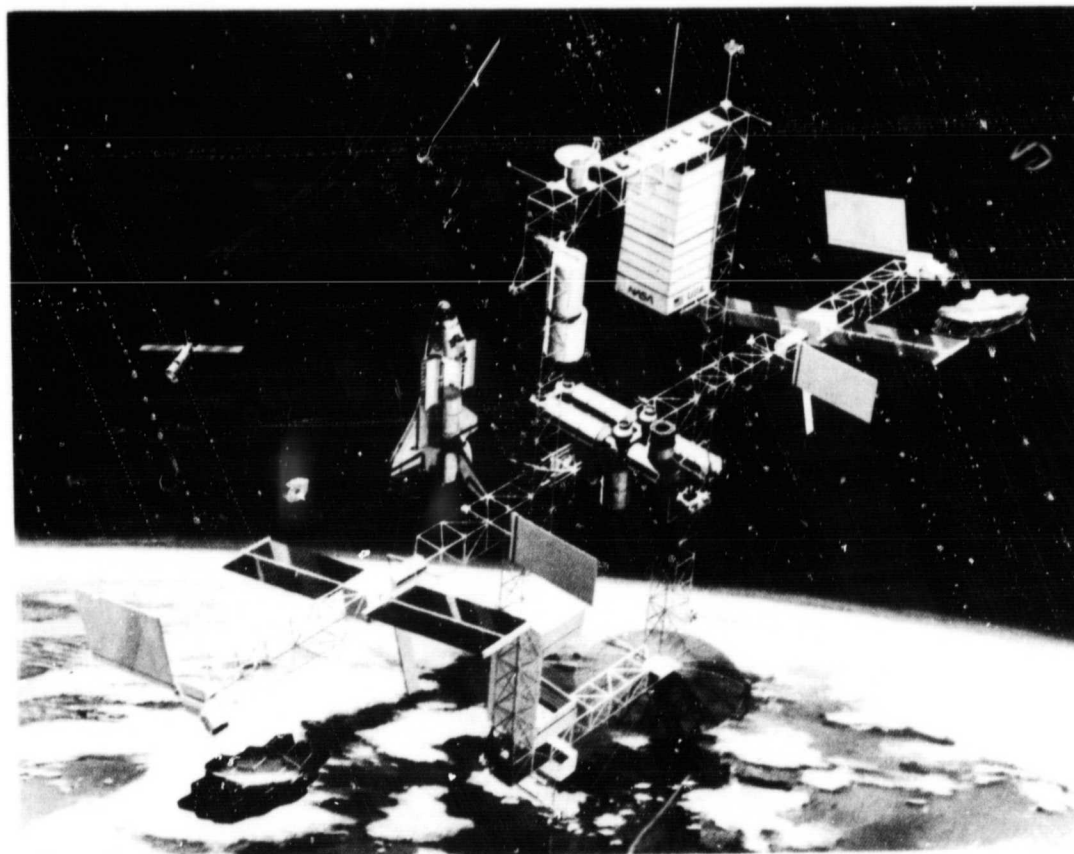
U.S. Department of Commerce
National Technical Information Service

NTIS

NASA/Contractor Team

Highlights of Contractor Initiatives in Quality Enhancement and Productivity Improvement

July 1986



NASA
National Aeronautics and
Space Administration

**Office of NASA Productivity Programs
Washington, D.C. 20546**

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Jul 86

PERFORMER: National Aeronautics and Space Administration,
Washington, DC. Office of NASA Productivity
Programs.

The NASA/Contractor Team efforts are presented for your information as part of NASA's continuing effort to facilitate the sharing of quality and productivity improvement ideas among its contractors. This compilation is not meant to be a comprehensive review of contractor initiatives nor does it necessarily express NASA's views. The submissions represent samples from a general survey, and were not edited by NASA. The efforts are examples of quality and productivity programs in private industry, and as such, highlight company efforts in individual areas. Topics range from modernization of equipment, hardware, and technology to management of human resources. Of particular interest are contractor initiatives which deal with measurement and evaluation data pertaining to quality and productivity performance.

KEYWORDS: *Contractors, *Productivity.

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NASA/Contractor Team

Highlights of Contractor Initiatives in Quality Enhancement and Productivity Improvement



July 1986

**The Office of NASA Productivity Programs
NASA Headquarters
Washington, D.C. 20546**

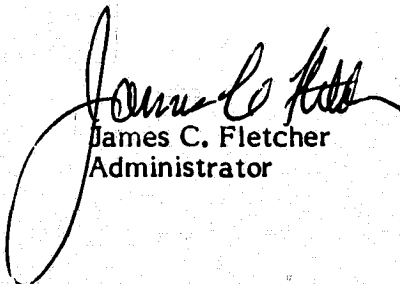
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FOREWORD

Increasing America's productivity is a critical national objective. The NASA Productivity Improvement and Quality Enhancement (PIQE) Program is a team effort of NASA and its private sector contractors to achieve that objective. Our joint continuing progress in productivity and quality improvement is a source of earned pride for all participants. Many NASA contractor organizations have demonstrated successful efforts to sustain high levels of technical performance and industrial productivity as they carry out their complex and demanding assignments.

Our greatest challenge now lies ahead--to develop and sustain viable methods of measuring and evaluating productivity and quality performance in the NASA/Contractor work force. We believe some of the accomplishments documented in this report represent various means to achieve this goal and set the pace for continued improvement.

It is with great satisfaction that NASA presents this sampling of the individual company initiatives that contribute so greatly to the Nation's civil aeronautics and space program.



James C. Fletcher
Administrator

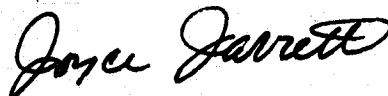
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PREFACE

The NASA/Contractor Team Highlights of Contractor Initiatives in Quality Enhancement and Productivity Improvement is presented for your information as part of NASA's continuing effort to facilitate the sharing of quality and productivity improvement ideas among its contractors. This compilation is not meant to be a comprehensive review of contractor initiatives nor does it necessarily express NASA's views. The submissions represent samples from a general survey, and were not edited by NASA.

The efforts are examples of quality and productivity programs in private industry, and as such, highlight company efforts in individual areas. Topics range from modernization of equipment, hardware, and technology to management of human resources. Of particular interest are contractor initiatives which deal with measurement and evaluation data pertaining to quality and productivity performance.

We are pleased with this first sampling and hope to elicit a more comprehensive response in the future. We believe the initiatives in this report are indicative of the strong commitment of the NASA contractor community to quality and productivity.



Joyce R. Jarrett, Acting Director
NASA Productivity Programs

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AIR PRODUCTS AND CHEMICALS, INC.
P.O. Box 538
Allentown, Pennsylvania 18105

Alber E. Greene
Corporate Director
Productivity and Quality
Systems
(215) 481-6250

Productivity and Quality have always been a part of the culture of Air Products and Chemicals, Inc. The company was actually founded upon an idea for improving productivity: the concept that on-site production and marketing of industrial gases is more cost effective and produces the highest quality level obtainable. Since 1981, formal productivity and quality efforts have been directed and guided by a corporate committee chaired by the president of Air Products and each group/staff department has its own plan and committee. In 1985 the management of productivity and quality was further focused by the creation of the position of a corporate quality director reporting to the president and, in the operating groups, the position of group quality manager was established. A corporate quality council also came into being at that time.

An extensive project management process drives productivity improvement with over 1000 projects being actively worked on throughout the company in 1985. These have resulted in real savings of nearly 2% of the 1985 cost base. Major strides were made in maintenance productivity (up 30% in the Chemicals Group), energy consumption (off 25% from the 1981 base for liquid oxygen/liquid nitrogen plants), and establishment of formal corporate employee involvement policy and guidelines. These new involvement programs generated over 1500 ideas from employees in 1985. Not all suggestions need be related to costs, but when combined with cost saving projects, they totaled nearly 3000 examples of employee interest in the productivity and quality of Air Products' goods and services. When combined with cross-functional analysis teams, value analysis office automation, CAD/CAM and organizational structure study, Air Products' idea power covers the full range of activities for achieving growth with profitability--from improving productivity and quality to stimulating continued innovation.

AIR
PRODUCTS 

INDUSTRIAL GASES

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best available copy.



A new generation of computerized process control equipment is replacing arrays of switches, gauges and indicators at Air Products' industrial gas plants, including this new

synthesis gas facility in Geismar, Louisiana. Using a keyboard and a computer, an operator can now control an entire plant, increasing efficiency while meeting high-quality product standards.

The BFEC Productivity Improvement and Quality Enhancement Program is managed by an Executive Committee composed of the President and two key vice-presidents. The Program is administered and directed by a Director of Productivity, reporting to the President, and a Productivity Council. Managers and supervisors implement and report productivity measures and employees are encouraged to participate in Productivity Enhancement Teams (PET).

From the initial PET established in September 1984 with a membership of 10 people, the program has expanded to 18 teams with 117 members today. Teams meet regularly in quality circle-type environments to discuss, investigate, and recommend productivity improvements. They receive training in structural problem solving, decision making and present specific recommendations and solutions to management.

Each department within BFEC prepares an annual plan containing the productivity improvement and quality enhancement goals of the department, individual roles and responsibilities for developing, implementing, scheduling and monitoring progress. Monthly progress reports are provided to the Director of Productivity and the BFEC President.

Examples of productivity gains include:

- At Goddard Space Flight Center, BFEC computer technicians assumed responsibility for maintenance of the VARIAN computer systems, thereby eliminating a maintenance sub-contract. This resulted in a yearly savings of \$116,750 with maintenance support provided 24 hours per day rather than the 8 hours per day provided under the subcontract.
- Prompt action to default a non-responsive software subcontractor and selection of a new vendor resulted in a 2-year savings of \$979,897 and a \$25,000 bonus in our award fee for our management initiative.
- A BFEC hardware design team integrated a hardware commonality requirement in support of GSFC's Systems Utilization Enhancement Project to ensure subsystems would be identical. A cost reduction of \$164,682 was realized.
- Management review and controls of travel schedules and methods for recruiters and interviewers resulted in a \$282,646 yearly cost saving to BFEC and our customers.
- Since 1977, the BFEC Cost Reduction Program has resulted in savings of more than \$33 million. In each year we have exceeded our goal of reducing costs by 2 percent of cost of sales.
- A BFEC financial analyst assigned to a Goddard Space Flight Center program installed an automated system for preparing cost reports on contract modifications for the customer. This reduced manpower requirements by 128 hours per year, eliminated manual key punch requirements and special computer operations, resulted in more timely and accurate reports and effected a \$9,000 per year cost savings.
- A quality assurance group on a NASA program assumed responsibility for maintaining development schedules for 30 software projects. By eliminating redundancies and improving quality control, a yearly cost savings of \$15,904 was realized.
- Employees in a contract administration department, concerned about the drain on company resources by the inefficient purchase and distribution of office supplies and equipment, developed new and innovative procedures for procurement, security, distribution, and use of supplies.

BFEC CONTACT: I. Krauze, Director of Productivity
Bendix Field Engineering Corporation
One Bendix Road
Columbia, Maryland 21045 (301) 794-9000

PROJECT FOCUS

AMETEK, Straza has developed a quality trends program in order to monitor product manufacture, detect trends and provide visibility to permit timely corrective action. Nonconformance data are recorded and stored on magnetic discs utilizing the Lanier LTE-4M word processing system. Each dual-sided, dual-density disc contains a 560,000 character storage capacity. The computer-like "smart disc" software permits a variety of applications such as tabulation, graph preparation and the collection, categorization and listing of selected nonconformance data.

From receipt of raw material through final product acceptance, as "out-of-print/spec" conditions are noted, the discrepancies are documented on an Inspection Report form. When these forms are routed through the Material Review Board process, each nonconforming characteristic is transformed into a line of data for magnetic disc storage, through careful extraction of specific information elements. The data lines are then grouped, rearranged, and displayed in numerous ways to provide a continuous pulse and ability to focus on nonconformance activity.

While "FOCUS" has been used as the central theme of our quality trends automation efforts, it is also an acronym representing the system development concepts as follows:

FLEXIBLE

Extensive retrieval capability to provide quick look and ability to penetrate as required.

OBJECTIVE

Originator input is recorded; no interpretation.

CURRENT

Immediate entry of data to detect problems at earliest possible stage.

UNDERSTANDABLE

Need for rapid analysis and evaluation by persons of varied experience requires plain language format and ready access to the source document.

SIMPLE

Necessary for timely data collection; only data required for rapid preliminary analysis are recorded.

The ability to "FOCUS" has enhanced our management of quality and has resulted in significant cost saving to ourselves and to our customers.

AMETEK

STRAZA DIVISION

ANSER
1215 Jefferson Davis Highway
Crystal Gateway 3, Suite 800
Arlington, Virginia 22202

Point of Contact: Joel M. Graybeal
(703) 685-3444

KEY PRODUCTIVITY AND QUALITY INITIATIVES

Awareness

We are striving to improve substantially the productivity and quality awareness throughout the company. In our new company newsletter (established in February '86), we are conveying to the staff messages from our CEO on productivity and quality. Our newsletter also contains new employee biographies, promotions, benefits and computer news, professional development opportunities, and other items of general interest. Our staff has responded very positively to this news communication vehicle.

Measurement

We are working closely with our main client, the Air Force, in a more systematic, "bottoms-up" assessment practice to measure the quality and effectiveness of our studies and analyses.

New Technology

ANSER has made a commitment to increasing productivity through new technology. In the past three years, we have increased the number of in-house computers by over ten fold and plan to acquire more. We also are making other technology investments, such as new publications equipment and library automation equipment which will increase substantially our productivity.

We have also demonstrated our commitment to new technology by introducing a new personal computer purchase assistance plan where ANSER subsidizes the cost of the computer or provides an interest free loan.

Professional Staff Development

We continue our emphasis on human resource development. In the past three years, our Educational Assistance Program has doubled in size. We have also recently reorganized our Professional Activities Program decentralizing the control of resources. We have also begun an intensive effort to establish an in-house training program with particular emphasis on computer skills. Recently, our entire management team underwent a thorough management training program.

Richard Myers
Phone (415) 694-5152
Calspan Corporation

ARVIN/CALSPAN

CALSPAN PRODUCTIVITY IMPROVEMENTS

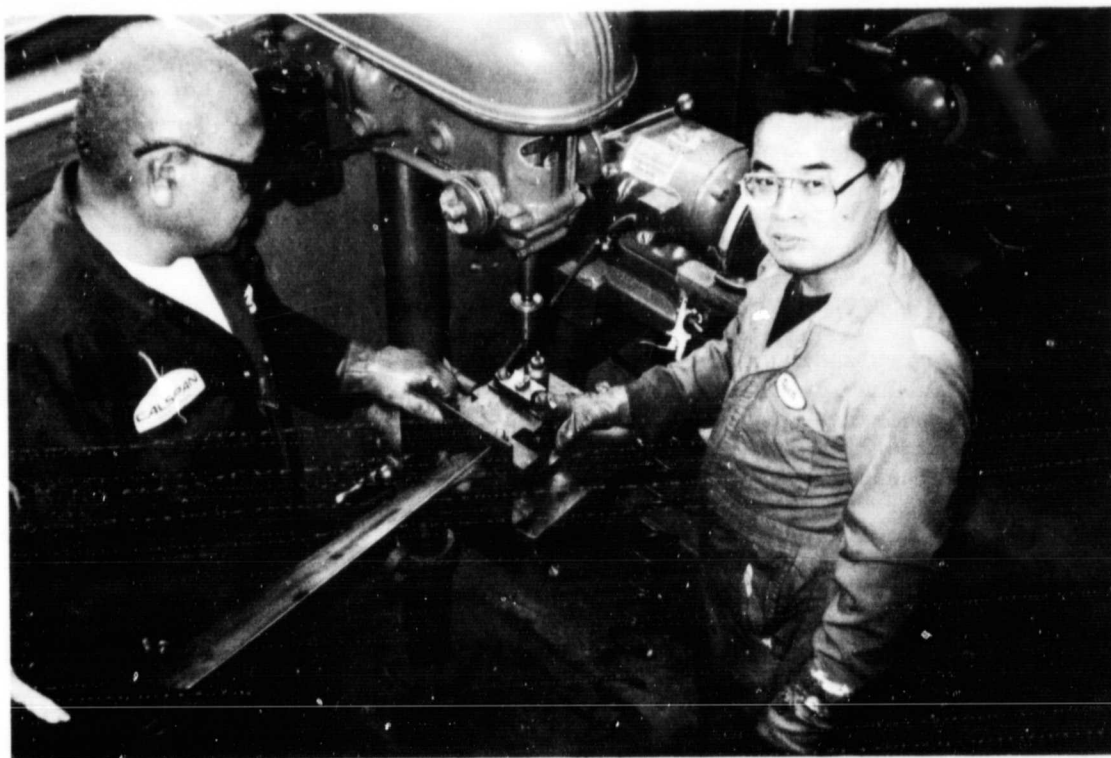
UPGRADE 6-FOOT SWT COMPRESSOR

The 416 blades of the compressor have been fitted with a pin arrangement which fixes the blade in a repeatable orientation in the cuff before torquing of the securing bolts. This eliminates the need for manually setting the blade angle with an inclinometer before torquing the securing bolts. This pinning method always insures the same blade angle which increases overall accuracy, eliminates many possibilities for human error in the blade angle setting process and decreases the time necessary to install the 416 blades. This upgrading to enhance productivity carries with it an overall quality improvement to the operation of the 6-foot SWT.

TEST OPERATIONS

A Project Engineering Guide for conducting tests in the NASA/Ames wind tunnels has been published. This general guide has been prepared for Calspan project engineers for auditing and conducting wind tunnel tests. The guide covers essential items common to all testing as well as items unique to specific tests. The document serves as a memory guide for conducting test programs. The information contained in the guide is used as a tool to increase the overall quality of the test data in a more efficient and productive manner. The appendix of this publication contains information, forms, and outlines for use by the project engineer throughout the test program. The guide also serves as a training mechanism for new project engineers and support personnel.

It is the general policy of Calspan to give the project engineer sufficient responsibility and authority for a project and to keep direct supervision to a level necessary for assurance of data quality and timeliness.



CALSPAN Craftsmen Drilling Pin Hole in 1 of 416 Wind Tunnel Compressor Blades for Permanent Blade Angle Setting. Previously Done Manually Each Time Blades Changed.

Avco Aerostructures **TEXTRON**

THE AVCO SMALL PARTS PENETRANT INSPECTION SYSTEM

The AVCO Small Parts Penetrant System is the newest addition to AVCO's inventory of Quality Assurance Non-Destructive Testing Equipment. This Penetrant Inspection System is designed to process and inspect aluminum aircraft parts under three feet in length. The Inspection System will be used on all aircraft programs at AVCO. When in full operation the system will have capacity in excess of 240,000 parts per year.

The Inspection System is designed to perform both pre-cleaning and inspection of parts in one continuous operation.

The pre-cleaning portion of the system is scheduled to begin operation in June of 1986. This portion of the System will consist of an alkaline cleaning tank, an alkaline etch tank, a deoxidation tank, and three immersion rinse tanks. Parts are moved from tank to tank using a small overhead crane and are immersed in the various solutions using a system of elevators. The cleaning and etching times are controlled using mechanical timers. The solutions are sufficiently active to provide a uniform etch ranging from .0002" to .0006" in 10 to 15 minutes.

The Penetrant Inspection portion of the system, scheduled to begin operation in April 1986, will utilize a water washable, fluorescent penetrant and a dry powder developer capable of achieving a Group VI⁺ sensitivity in accordance with MIL-I-25135. Parts will be immersed in the penetrant tank using an automatically timed elevator. Developer is applied in a fully enclosed fan-driven tank, which has a developer suction system for removal of excess developer from the environment.

Both the penetrant wash and the post-inspection wash tanks use hand held water spray systems with air injection for uniform dispersal of water over the parts. The dryers are designed to uniformly dry each load of parts in 8 to 10 minutes.

The Penetrant Inspection System is being built by Ardrex Incorporated of La Mirada, California and installed by NEWCO Incorporated of Atlanta, Georgia.

When completed, this unit will form an integral part of AVCO's total NDT Inspection System. Along with the three penetrant systems already in operation this unit will give AVCO an estimated Penetrant Inspection capacity in excess of 460,000 parts, with a capability to inspect parts ranging in size up to 90 feet in length. In addition to Penetrant Inspection, AVCO also performs non-destructive testing utilizing radiographic, ultrasonic, eddy current and magnetic particle inspection techniques.

Reported by: Mark Biggerstaff
Avco Aerostructures/TEXTRON
P.O. Box 210
Nashville, TN 37202
(615) 360-4064

May 8, 1986

1717 West Collins Ave.
Orange, CA 92667-5422
(714) 633-3700
TWX (910) 595-1517

Subject: Results - "Key Productivity & Quality Initiatives"
@ Babcock, Inc., Orange, California

Thank you for the opportunity to advise you of our Company's initiative to improve and generate interest in product quality and productivity. Our efforts are best communicated by listing them and some appropriate remarks:

<u>ITEM</u>	<u>REMARKS</u>
1. Statistical process control on critical processes	Established on quantitative parameters that give a measure of cumulative sub-assembly capability with respect to customer specifications.
2. Cross-training of production personnel	Provides individuals with initiative opportunities at various tasks, eliminate boredom and increases opportunity for advancement.
3. "Qualification" of in-process test equipment in support of customer acceptance testing	Subject company owned in-process test gear to the same rigorous qualifications of maintenance and calibration to provide back-up during end of month peak work load.
4. "PERT" - Production Event Review Technique	A system of relating all production control events to each other. Indicating interacting constraints and identifying the critical path for timely accomplishment.
5. "Employee of the Month" recognition	Public recognition designed to acknowledge and promote individual contribution to productivity.

Needless to say, productivity initiatives is a continuous endeavor. In our monthly company gatherings we not only encourage the airing of complaints but also take that opportunity to solicit ideas that may enhance our corporate policy of promoting "Productivity and Quality Initiatives".



QUALITY AND PRODUCTIVITY IMPROVEMENT AT BALL AEROSPACE

Ball Aerospace Systems Division

Vern Rogowski, Director of Quality/Productivity Improvement

P.O. Box 1062, MD: BE-7

Boulder, Colorado 80306

(303) 939-4110

Ball Aerospace Systems Division (BASD) is committed to meeting "The Challenge: Pride in Excellence". About a year and a half ago, BASD embarked on a long-term program to achieve continuous improvement in the quality and productivity of all our operations. Drawing on the training, experience, and methodology of quality experts such as Philip B. Cosby and Dr. J.M. Juran, we developed a program of education, management leadership, and teamwork designed to accomplish that goal. We call this program "The Challenge: Pride in Excellence".

This program was initiated and is being driven by our new President, Dr. Richard N. Herring and his Vice-Presidents. After completing Crosby's Quality College, they formed the Executive Improvement Team that meets twice a month to plan, direct, and monitor the division-wide implementation of quality and productivity improvement. Ron Hart, Vice-President of Production Operations, is Chairman of that team and Vern Rogowski, Director of Engineering Services, is director of the "Pride in Excellence" program. So far the program has focused on quality improvement and on building an awareness, understanding, and commitment -- first among managers and now all other employees -- to doing things right the first time, preventing errors and defects, and resolving chronic problems.

The major accomplishments during the past year include:

- A mission statement and ten management principles have been published and distributed to all managers and soon all other employees. The mission is: "Ball Aerospace will meet all customer requirements for quality hardware and services including performance, schedule, and cost. We will continue to preserve and enhance our traditions of technical innovation, professional excellence, and pride in our work."

- Over 200 managers and 400 employees have completed a training seminar on the philosophy and methodology of quality improvement. All 2,000 employees will complete this by June 30, 1986.

- Organization Improvement Teams reporting to the Executive Improvement Team have been formed to ensure implementation of the program in our business units.

- Nine project teams have been formed, trained in Juran methods, and have worked (or are working) on specific quality problems. Two have completed their work and resulted in procedures which will prevent vacuum leaks in joints of cryogenic systems and nonconforming parts from the N.C. Machining system.

- An Error Cause Removal process has been established to encourage employees to surface errors and roadblocks to doing their jobs right and to cause managers and supervisors to correct and prevent those nonconformances.

Beech Aircraft Corporation

Boulder Division
Box 9631, Boulder, Colorado 80301
U. S. A.
(303) 443-1650

Direct inquiries to: Doug Addy

The Productivity Improvement Program at Beech Aircraft, which is known as the Productivity Council, has been in existence since 1976 and still functions actively today. The purpose of the Beech Productivity Council is to provide a means of effective communications between one Beechcrafter and his fellow Beechcrafters, including management, concerning common efforts to improve all the things around them that affect their job and the impact it may have on our product. Directly related to the purpose of our program is the basic philosophy that the employee is the expert at his or her job, and it is the Council's responsibility to: First - listen to the employee's ideas concerning improvements; Second - get back with the employee to discuss his ideas; Third - do something about it. The objective of this program is to reward (monetary) our people for their ideas concerning lower cost, better quality and a safer work place.

The Productivity Council at the Boulder Division of Beech Aircraft received 250 proposals in 1985. Of these, 173 proposals were instituted and 13,240 dollars were awarded.

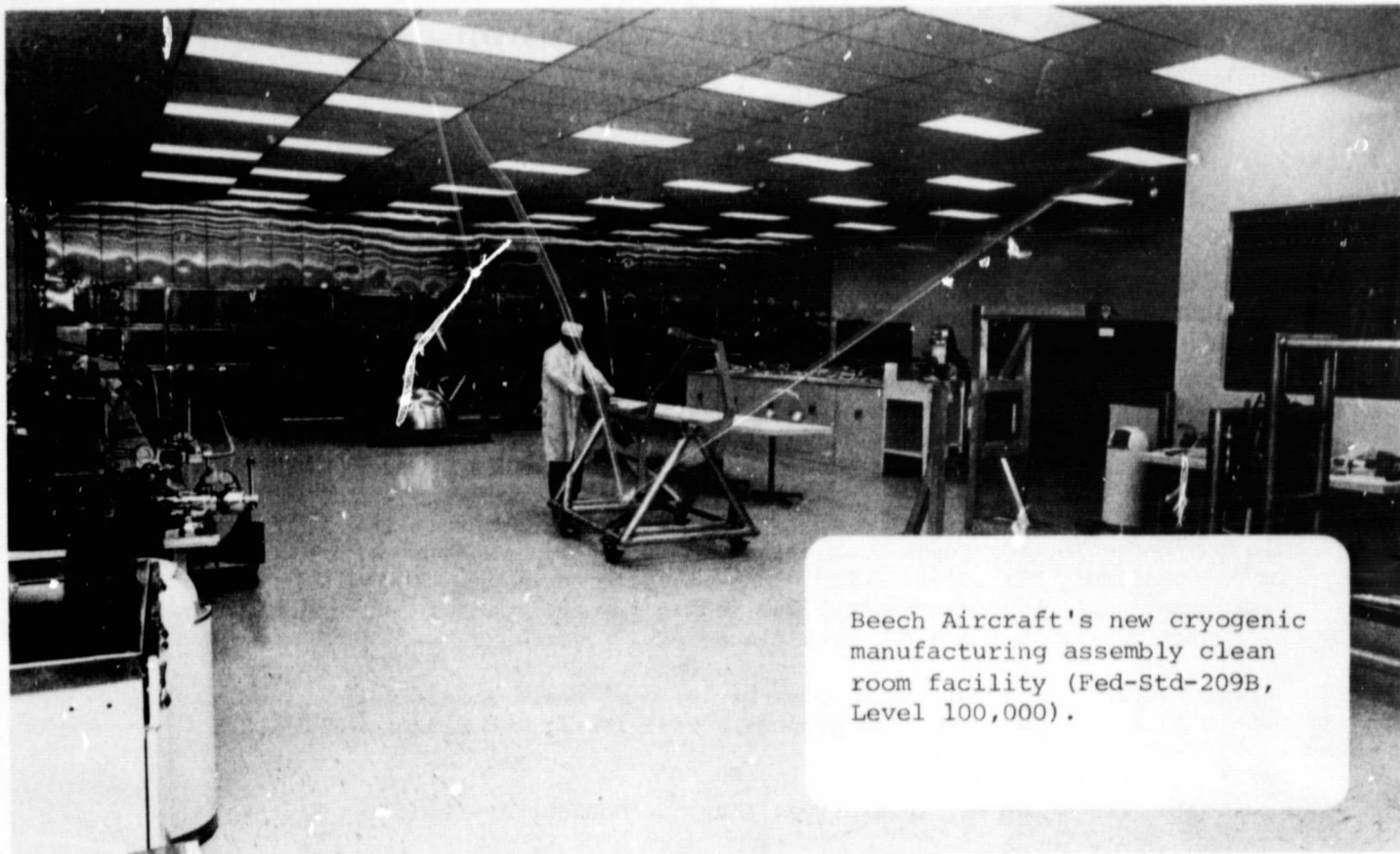
The following are a few key initiatives that the Boulder Division has instituted:

- o New Equipment - Installed an automated cryo pump vacuum system in place of a diffusion pump vacuum system. The 30-day vacuum acquisition process required 24 hour man coverage when utilizing the diffusion pump vacuum system. The new cryo pump vacuum system has eliminated the need for 24 hour man coverage.
- o New Technique - Utilizing radiographic (X-ray) techniques, developed a new nondestructive method to evaluate weld mismatch on a pressure vessel in a completed vacuum cryo vessel (double-wall tank). This technique allowed the evaluation of a pressure vessel mismatch on a completed tank assembly without disassembling the tank. This technique was so unique that it was granted Patent Number 4,542,520.
- o New Facilities - Beech Aircraft Boulder Division recently constructed a new manufacturing clean room facility which was designed to meet the requirements of Fed-Std-209. This facility houses a manufacturing assembly room (Level 100,000), an ultra clean room (Level 100), and a humidity and temperature controlled insulation lay-up room.

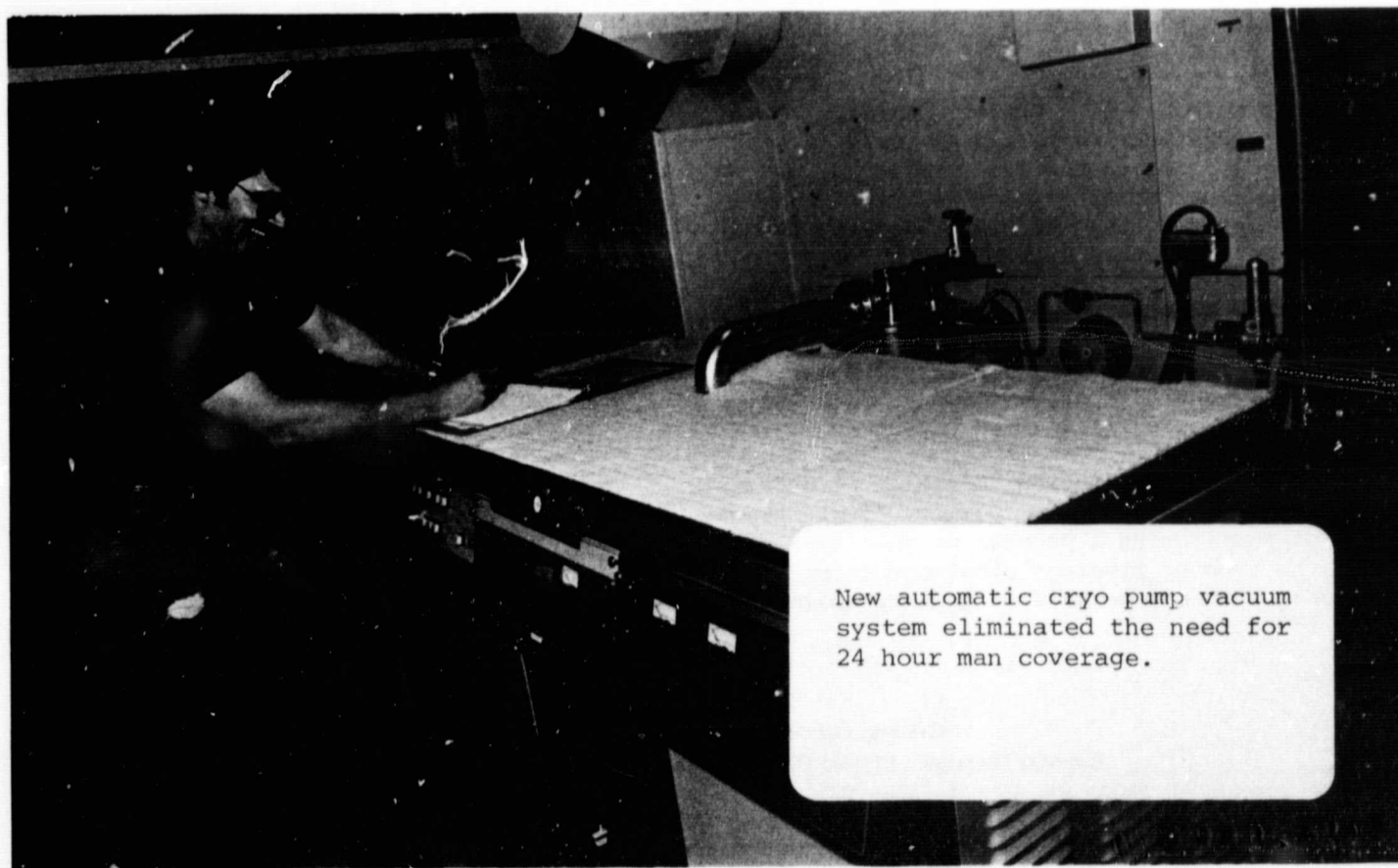
Beech Aircraft Boulder Division is currently in the process of evaluating quality enhancement programs (Quality Circle type). Our Division is in the early stage of instituting a program of this type. In this area, Beech Boulder has researched the type of programs other companies are using, the results of their programs, and has sent key members of quality and manufacturing to circle leadership training courses.

General Offices: Wichita, Kansas, U.S.A.
Boulder Division Liberal Division Salina Division Selma Division

A Raytheon Company



Beech Aircraft's new cryogenic manufacturing assembly clean room facility (Fed-Std-209B, Level 100,000).



New automatic cryo pump vacuum system eliminated the need for 24 hour man coverage.

The Bionetics Corporation
20 Research Drive
Hampton, VA 23666

Contact: Mr. Jerome Meyers,
Quality Assurance
Director
804/865-0880

At Kennedy Space Center under Subcontract LSOC/10900/000006, Standards and Calibration, a number of activities have resulted in increased productivity.

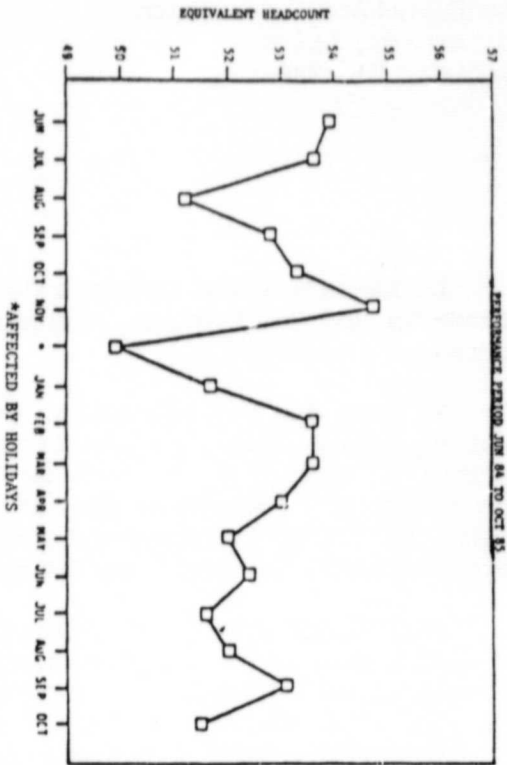
We have applied automation of all major calibration activities. The test equipment loan pool was automated to enable computer tracking and control of each item, to include check in/out and calibration requirements. The manual production control system was also automated to allow reporting, tracking and plotting of production by computer. All report preparation has been automated.

Facilities were consolidated to take maximum advantage of commonality of equipment and to decrease movement and transportation. The calibration recycle times of test equipment were adjusted to maximize reliability in the field and reduce turn-ins to achieve an 85% reliability. Additionally, the monthly recall system was adjusted to a bi-weekly system to smooth the transportation and workload problems, thereby increasing efficiency and productivity. A system to store tools in the Shuttle Vertical Assembly Building was implemented to reduce travel and transportation time.

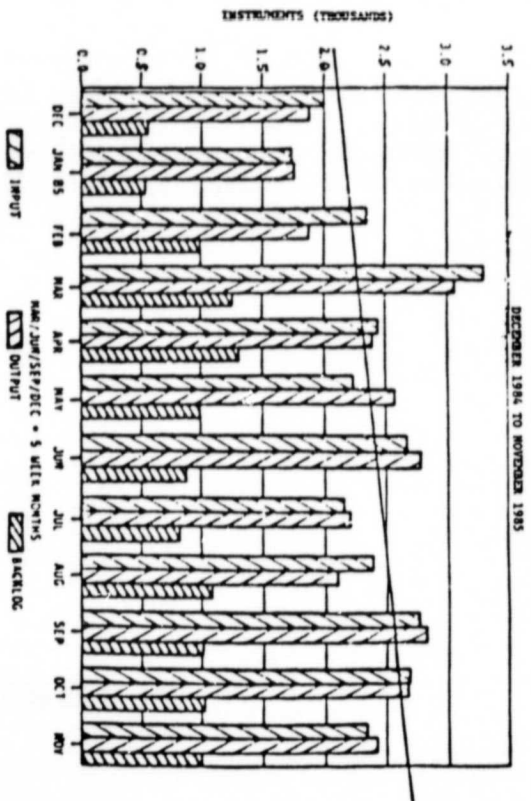
As a result of these activities, in fiscal year 1985 the cost of materials was 6 per cent under budget; turnover of personnel is less than 8 per cent. Production has increased over the past year by 28 per cent, cost of calibration has decreased by 28 per cent. Savings on the contract amounted to approximately \$156,000.

the **bionetics** corporation

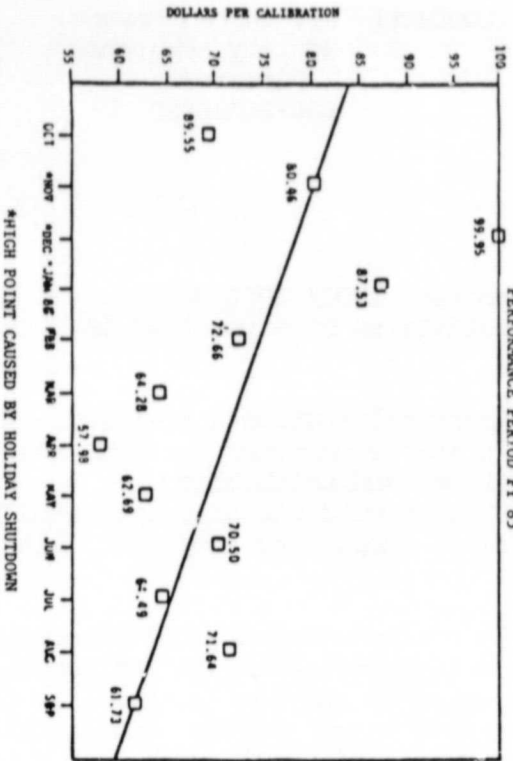
EQUIVALENT MANPOWER



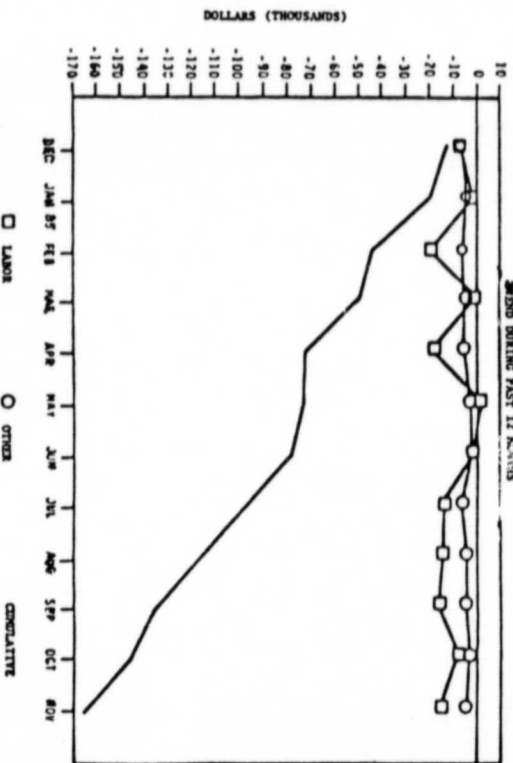
BIONETICS PRODUCTION CHART



BIONETICS COST/CALIBRATION



INCURRED LABOR AND OTHER COST DEVIATION



THE BIONETICS CORPORATION
 Productivity and Quality Trends
 FY 1985 - Standards and Calibration Support
 Kennedy Space Center

BOEING AEROSPACE COMPANY

SEATTLE, WASHINGTON 98124

**Quality Improvement Center, Boeing Aerospace Company
Scott Kaseburg, MS 85-15, P.O. Box 3999, Seattle, WA 98124, (206) 773-0228**

Quality Improvement at the Boeing Aerospace Company

Continuous improvement in quality has always been the way of life at Boeing Aerospace Company (BAC). Recently, a structured process of quality improvement has been initiated to drive the company to higher and higher levels of performance. This effort is being led by the Pride in Performance Steering Committee, which is made up of senior managers and reports to the president. The committee meets monthly to direct company-wide efforts to improve quality and productivity.

During 1985, 30 groups of managers, including senior management, were trained in the strategies and tools of the improvement process. The Steering Committee and all 13 Quality Councils were trained together as functional groups. In total, more than 30% of the company's management, beginning at the top level, received eight hours or more of training in quality improvement during the year.

The Quality Councils conducted a wide variety of quality improvement projects in 1985 and are expanding their efforts for 1986. These are accomplished through Improvement Teams, made up of groups of managers who search out problem areas, research the problems, determine courses of action, and oversee implementation of these recommendations. Twenty-eight Improvement Teams were active in BAC during 1985, working a wide variety of problems.

A few examples of the results achieved through this process are the following:

A project to reduce request for quotation cycle time in Research and Engineering has decreased delinquencies per month by 71%. One improvement team in Industrial Relations (IR) reduced the time it takes to hire an engineer by more than half. Another IR team cut flowtime through Compensation by more than 20% while eliminating 57% of the paperwork that even had to come through the department. A team in the Ballistic Systems Division reduced the flowtime for generation of parts lists by 58%. A project in Finance decreased the number of labor adjustments by 31%. And in Business Development, a team working on providing better flowtimes for proposal text and art produced over \$280,000 in savings.

During the year, Quality Circles nearly doubled, expanding from 55 to 97, with 856 employees currently involved in efforts which have produced over 2.5 million dollars in savings. One of these, the Universal Heads Circle in Manufacturing, won two \$10,000 awards and was selected to tell their success story at the annual convention of the International Association of Quality Circles. And to bring home the message to our suppliers, BAC held its first annual supplier quality symposium in October, 1985, drawing 80 top executives and quality improvement professionals.

In 1986, these efforts are being greatly expanded, now that the quality improvement process at BAC is fully hitting its stride. The Quality Councils have all developed and are implementing their plans for 1986 to focus the improvement effort at BAC throughout the year.

CADAM INC

PRODUCTIVITY INITIATIVES

A major commitment which CADAM INC has made to facilitate productivity in the area of software development, validation and testing, is that of providing optimum computer resource availability on a company-wide basis. An aggressive program to supply the most up-to-date technological "tools" along with extensive electronic networking needed by the software staff and management where appropriate, and the purchase of the largest IBM mainframe computer system available to provide the most powerful computing resources, insure optimum response time and full support of each individual's development effort without overload delays, etc. As a shortage of resources, delays or slow response time can greatly impair the software program development process, the result of this program has positively impacted productivity.

CADAM INC is also committed to the training and development of its employees. Comprehensive internal training programs provide newly employed personnel with the skills needed to become productive quickly. Advanced technology courses provide additional training to increase the productivity levels of experienced software personnel. CADAM has also made a significant commitment to management training. Three levels of management training have been implemented with over 70 managers participating in the program. The management training program provides both entry level, middle management, and senior managers with the management tools needed to foster productivity and positive group contributions needed to meet company goals and objectives.

Results of Some Key Productivity and Quality Initiatives at System Sciences Division of Computer Sciences Corporation

CSC/SSD has a 35 month NASA/Goddard Space Flight Center contract for the development and implementation of a real-time data capture software system called Packet Processor (PACOR)/Gamma Ray Observatory (GRO). The Cost-Plus Award Fee (CPAF) contract contains a Productivity Improvement Program clause that gives CSC the opportunity to increase the fee by achieving cost savings. Award fees are based on the evaluation of end-item deliverables. The NASA/CSC objective is to improve the software development environment by using automated tools to support the software development life cycle. The expected results are improved product quality and project productivity.

NASA chose the PACOR/GRO Project as a full implementation test case for automation and funded an evaluation study for automated tool selection. CSC/SSD conducted the evaluation of available tools, ultimately selecting two candidate systems for a 90-day evaluation. At the completion of the evaluation CSC selected the NASTEC CASE 2000 Programmer/Analyst workstation for the project.

Workstations were utilized strictly by the technical staff for software development activities. All of the software requirements analysis phase products were generated on the workstations. All preliminary and detailed design phase technical products were generated on the workstations. The workstations are being used to support the implementation activity on the target computer by maintaining existing documentation, PDL, and test plans.

Results to date have been very encouraging. Not only has the client been pleased with the rigorous specifications produced, and the end-items delivered, but management and staff reaction to automation was very positive. In the preliminary design phase SSD received a 98% award fee. In the detailed design phase, an exacting design was achieved and customer satisfaction was high, as demonstrated by 100% award fee. No action items or review item dispositions were received after the critical design review (CDR).

PACOR/GRO used fewer hours for requirements analysis and design than called for by the productivity plan. The design was delivered one month early, was under the tightly-budgeted cost, and it contained more information than previous similar system designs developed with traditional methods. The workstations helped promote a rigorous approach to software development. The depth and breadth of the final software design was exemplary and all participants, client, management, and technical staff became progressively more enthusiastic about automation as the project progressed.

Workstations are proving to be a very positive step in improving the software development process. When the project is completed, CSC/SSD will have a quantifiable measurement of the improvement in quality and productivity.

COMPUTER SCIENCES CORPORATION

SYSTEM SCIENCES DIVISION

(301) 589-1545

8728 COLESVILLE ROAD • SILVER SPRING, MARYLAND 20910

QUALITY IMPROVEMENT: FUNDAMENTAL TO SUCCESS

To achieve our goal of supplying defect-free products and services, Control Data Corporation, as well as CDC Government Systems, has implemented a quality improvement effort we call our Total Quality Management Process, (TQMP). TQMP is a process of single-minded attention to continuous quality improvement in which improved productivity and improved costs will naturally flow.

TQMP implementation methodology includes a high-level steering committee in each organization which meets regularly; 3 - 5 processes chosen by management to concentrate improvement methods on; Quality Improvement Plans for each part of the process undergoing improvement; an owner designated for that quality improvement plan; key process measurements which reflect the activity. Progress against the quality improvement plans and measured activity are reviewed at monthly meetings with the President of the Government Systems Group.

Some examples of quality achievements are:

- Our first priority goal for Manufacturing in 1985 was to improve the AN/AYK-14 Standard Airborne Computer factory demonstrated Mean Time Between Failure (MTBF). The following data shows the progress achieved as of July 1985:

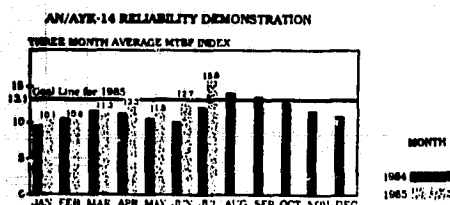


Table 1 compares 1984, 1985 Goal and July 1985 performance

Table 1: Real Time AYK-14 AET Performance			
Parameter	1984	1985 Goal	1985 July
Mean for year (HRS)	11.5	13.1	14.6
One Standard Deviation	1.29	0.86	6.01

This MTBF growth was achieved in spite of the fact that our equivalent system deliveries increased by 172% over 1984 deliveries.

- Warranty requirements in the Standard Navy Militarized Disk (UYH-3) have been eliminated as a result of the continuing reliability growth. At the same time, systems delivery growth goal set for 1985 was 149%, actual growth as of June was 166%.
- Integrated Circuits used on the Standard Airborne Computer AN/AYK-14 Failure Summary shows significant improvements:
 - Receiving inspection fallout in 1980, 2.0%, in 1985, 0.3% or 3000 PPM.
 - Field failures/Mil hr in 1980 were 0.72, in 1985 they were 0.11.
- In the late 1970's, Control Data instituted a Quality/Reliability Improvement Plan on the Navy AYK-14 digital computer, whereby 100% functional test and temperature cycling was imposed on all semiconductor components. In addition, stress screening, at the Assembly and System level, was also implemented. This action assisted in delivering a highly reliable digital computer to the Navy Fleet installed in the F-18 Aircraft, which has been reported one of the most reliable aircraft delivered to the fleet. Most important of all is support from the top; in an interview with Boyd Jones, President, Government Systems Group talks about his own involvement: "I want to be completely involved. I plan to go and ask people at all levels of our organization specific questions in relationship to what they individually or collectively are doing about TQMP. I want to be looked upon as a leader for TQMP."



DIGITAL'S XSEL/XCON SYSTEM

For over twenty-five (25) years, Digital Equipment Corporation has been one of the leading and fastest growing manufacturers of computer hardware in the industry. Due to this rapid growth, a problem of major significance developed in recent years regarding the configuration and assembly task of our complex and diversified computers.

THE PROBLEM

1. The configuration of each DIGITAL system tends to be customized.
2. Over time, the size and complexity of the systems have grown.
3. DIGITAL has over 4,000 sales reps performing the functional sales task.
4. The process is constantly changing. The number of parts and the functional requirement is different in each case.

THE SOLUTION

In order to address this problem, DIGITAL has provided its sales force, operations personnel, and manufacturing plants two (2) artificial intelligence based expert systems. They are:

XSEL - Expert Selling Assistant System
XCON - Expert Configurator System.

XSEL is an on-line program that helps you design a computer at a high level of abstraction given a set of building blocks or components. It makes sure you have all the major subsystems of a functional computer system. XCON can configure systems to a much greater level of detail. It also shows you how to wire the electrical system and where each component fits. Additionally, XCON/XSEL allows us to incrementally add knowledge without reworking the entire system.

THE BENEFITS

The XCON/XSEL system has increased the company's productivity significantly and provided the following benefits:

- A. Sales representatives using XSEL configure systems 9 faster.
- B. XSEL always configures the same system the same way.
- C. XCON and XSEL provide a 98% accuracy rating in comparison with the average human configurator of 75%.
- D. XCON has saved DIGITAL approximately \$10M in its first year in customer allowances granted for configuration mistakes.

DIGITAL is very pleased with the results of the XSEL/XCON program and plans its continued enhancement and use as an integral part of our corporation's business. For additional information, contact Mr. Bruce McDonald, XSEL Product Manager, (617) 568-5336.



RE: EG&G/NASA PRODUCTIVITY AND QUALITY INITIATIVES - 1985

COMPANY PROFILE: EG&G, Incorporated is a widely diversified, technology-oriented corporation serving 165 highly specialized business elements. EG&G presents a unique spectrum of technologies that are easily applied to government contract work, particularly for the National Aeronautics and Space Administration, the Department of Energy, and various elements within the Department of Defense.

EG&G FLORIDA
Kennedy Space Center, Florida

Management of base technical operations, administrative services, utilities, facilities and health and security services at KSC.

- * **New centralized information management system for administering and tracking work and customer services, keeping NASA officials up-to-date on all projects and programs, which results in improved time efficiency.**
- * **On-going renovation and installation of advanced electronic security systems, providing greater facility and perimeter safeguards for the space center. The new operations emphasize random, mobile patrols over fixed post locations.**
- * **Installation of programmable logic controllers to improve utility systems management to control entrances and exits. Such systems are used to control accesses to the environmentally controlled Orbiter Processing Facility.**
- * **Installation and operation of the new computerized tomography equipment which revolutionized the space center's nondestructive examination of components program.**
- * **Installation and maintenance of new waste disposal method to recycle trash, providing heat for various center buildings, and saving thousands of dollars annually.**
- * **Employee suggestion system, with emphasis on productivity improvement, resulted in more than \$700,000 savings in 1985.**
- * **Provided 59,900 hours of training to more than 12,000 individuals from JFK Space Center and other NASA facilities, flight centers and air force bases, preparing them to perform duties with a high degree of efficiency and accuracy.**

EG&G CORPORATE ENTITIES

EG&G WASHINGTON ANALYTICAL SERVICES CENTER (WASC) Rockville, MD (Headquarters)

Engineering, scientific, and technical support services for space and ocean, defense and energy programs. Support work for NASA Goddard Space Flight Center involving data analysis, error analysis, and scientific applications software development.

- * Design and analysis of office-wide microcomputing facility tying EG&G programmers and analysts into NASA computers through a high speed communications link, expediting response time by 1 1/2 times, and reducing paper consumption, and travel expenses to and from NASA. This link also improves the correctness and validity of the scientific results.

EG&G IDAHO Idaho National Engineering Laboratory (INEL) Idaho Falls, ID

Support to the Department of Energy's nuclear and non-nuclear energy programs. Developmental work being performed on the Space Power-100 Reactor, the next generation of energy-efficient power plants for the Space Station, and other satellite systems.

EG&G SEALOL Warwick, RI (Headquarters)

Manufacturers of seals and bellows devices used in engines, motors, gearboxes, pumps, and compressors. Applications in aerospace, marine, military, petrochemical, chemical processing and other industrial markets. Recipient of U.S. Senate Productivity Award in 1984.

- * Division produces missile accumulators, turbine seals, liquid coolant systems, pump and alternator seals, and cryogenic cooler seals for the Space Shuttle and other aerospace flight systems. Cost-effective design and manufacturing processes have been implemented routinely.


EG&G ROTRON Woodstock, NY

Manufacturers of fans and blowers for aerospace and industrial applications.

- * Energy-efficient fans and cooling systems for spacecraft and ground support equipment. Critical ventilation in the Space Lab work station for animals have been provided by EG&G Rotron centrifugal blowers.

#

Focal Point: David Dallas
Telephone: 713-280-6003


Ford Aerospace &
Communications Corporation
Post Office Box 58487
Houston, Texas 77258-8487

Ford Aerospace has been providing systems and services in support of NASA for more than 23 years from its Houston, Tx. and College Park, Md. locations. Quality products and continuous improvement have always been important criteria for our success, and in recent years, our PIQE initiatives have stressed involved employees and increased automation.

Because employees are among our most important assets, a policy of participative management/employee involvement has been established throughout Ford Motor Company. One of our primary objectives is to achieve and sustain a participative management style throughout this Operation. It is being accomplished through a series of Participative Management Seminars (PMS) - training sessions of managers working with his/her manager to determine inhibitors to and opportunities for improved performance. These seminars have been held at several overlapping levels to ensure the commitment to a participative management style is well understood. For first line organizations, we established Employee Participation Groups (EPG) - groups of employees meeting with their supervisor regularly to identify and solve work related problems. In this Operation, 85 of our managers have attended one or more PMS, 137 people have attended the 3 day EPG leader training, and more than 700 non-supervisory people received EPG member training.

Success of the EPG process is both quantifiable and anecdotal. One EPG's efforts have resulted in a cost savings of more than \$100,000 that is still increasing. It was accomplished by increasing the reuse of software through the development of a properly indexed pilot library of software routines and programs (see attached photograph). Another EPG developed and implemented, with NASA approval, "permanent" personnel certification cards at annual savings of \$7250. Other indicators of success are in these quotes from our EPG Newsletter: "...we do believe deeply in the benefits attained by company-wide involvement in EPG's"; "We have all been amazed and pleased with our results thus far, and are now strong believers in the EPG process."; "One of the surprising observations...has been the surfacing of hidden talents that each member of this unit possesses."

Ford Aerospace employees have participated in NETS at the Johnson Space Center to improve the procedures for flight simulation safety and for handling correspondence associated with the astronaut office. Employees are also involved in our Cost Reduction and Employee Suggestion Programs which in 1985 resulted in savings of more than \$3 million and \$2.2 million to date in 1986.

In automation, a primary area addressed was expanded acquisition and use of personal computers throughout the Operation. We are now using over 100 PC's, and in a recent Corporate conducted survey, savings averaging \$16,200 annually per PC were reported. Some examples are a Software Systems organization saving \$6000 annually per PC by generating software code faster. Savings of \$20,000 per PC were reported in Financial Analysis through the use of PC's and electronic worksheets. The Publications Section saved about 500 manhours of keyboard entry and proofing effort in the first two months of PC use.

Our processes recognize employees are our key to success. Employee input will be solicited on decisions affecting their work so that we continue to achieve quality in our products and ever improving organizational performance.



Ford Aerospace employees
are shown at the terminal
of the reuseable software
library.



News

GTE Government Systems
100 First Avenue
Waltham, MA 02254

Release Date:

Prepared for:
National Aeronautics and Space Administration
Productivity improvement report

GTE Government Systems
Communication Systems Division
Irving Shapiro, director Product Assurance
77 A. Street
Needham Heights, MA 02194-9123
Tel: 617 - 449 - 2000

Quality Enhancement at GTE's Communication Systems Division

An all new Microelectronics Center and the implementation of Surface Mount Technology are the latest examples of the commitment to quality at the Communication Systems Division (CSD) of GTE's Government Systems Corporation, with headquarters in Needham, Mass.

CSD, which has facilities and offices in six states, designs, manufactures and installs command, control and communication systems for government users, military forces and commercial organizations worldwide.

The new multi-million dollar microelectronics engineering center opened this month with state-of-the-art laboratory facilities and computer-aided design tools for designing, testing and producing microcircuit chips and circuit boards, including VLSI/VHSIC-like chips.

The division's Surface Mount Technology is used in its printed circuit board assembly operation. This highly automatic process is designed to improve productivity and quality.



Computer aided design (CAD) within
GTE's all new microelectronics
center in Needham, Massachusetts

**Focal Point: Mike Humbolt, Program Manager
Gates Learjet Corporation
Aerospace Division
P.O. Box 7707
Wichita, KS 67277
(316) 946-2660**

Learjet has installed an automated chem processing line replacing it's outmoded line that had been in place since the 60's. This new system has 30' long tanks and combines state of the art handling with a modern waste treatment facility. the process line is strategically located by a new automated paint line. These two lines represent a substantial investment to improve quality and improve productivity.

Learjet has also installed a computer-controlled shotpeen forming and saturation peening system. This system has the ability to consistently contour form parts such as wing skins up to 10' wide and 24' long to $\pm .010$ tolerance. Significant value improvement and cost reductions result from this process when compared to previously used roll and bump forming processes.

Learjet is in the final stages of installing a five-axis automated fastening system. This computer-controlled gantry drilling/riveting system ensures economical and consistent installation of mechanical fasteners in large sheet metal structures such as those in the intertank panels.

GENERAL DYNAMICS CORPORATION
Operations & Engineering

The General Dynamics Corporation has been extensively involved with Productivity and Quality Improvement programs for many years. A large number of initiatives are being exercised across the corporation. These initiatives include incentivizing personal productivity and quality, incorporation of technology on the factory floor and in the office area, supplier involvement and innovative process changes.

A major cost of many of our products is the procured material. The Convair Division has activated a "Supplier Motivation" program wherein over 16,400 supplier personnel have been provided a 30 minute awareness presentation by Convair personnel. Prime elements of the presentation include an understanding of their equipment's relationship to the total program, the importance of the quality to the customer and consequences of failure. The program results have shown a 1/2 to 3/4 reduction in Rejected Purchased Items, Inspection Escapes and Late Material Deliveries. The Fort Worth Division is the leader in incentivizing subcontractor technology modernization. The program is expected to provide more than \$1B to DoD savings by 1990.

Manufacturing process changes are a prime element in reducing material costs and labor costs. The Land Systems Division selected High Deposition Rate Welding process which increased the deposition rate and improved quality for U.S. Army Tanks that will result in savings exceeding \$5.5M per year when fully implemented. Considering this initiative and others implemented at Land Systems Division over the last three years, there has been a reduction of greater than 35% in labor hours to produce a tank. Improvement of the processes and incorporation of high technology equipment at Fort Worth resulted in 75% reduction of manhour content in F-16 aircraft.

Productivity and quality result primarily from an enlightened workforce. Personnel incentivization programs across the Corporation are highlighted by the Production Quality Improvement program at Pomona wherein Production Department teams are incentivized to reduce scrap and rework. Establishment of challenging goals and the presentation of monthly and annual awards for the teams achieving the highest waste reduction has resulted in 25% reduction since program inception. The Electronics Division "Focus on Excellence" which rewards employees for improvement in yields, attendance and performance has resulted in over \$1M in savings since the program started. Currently more than 1100 employees are participating.

Significant changes in traditional construction methods for submarines have substantially reduced costs at the Electric Boat Division since 1982. The change encompasses completing submarine hull sections in a shop environment at a remote fabrication facility and then being transported to the ship yard for final assembly and tests. Benefits include improved personnel working conditions and accessibility to the work. This pre-packaging is allowing an evolution from unique skills to a product-oriented workforce.

The bottomline results of these broadbased initiatives has been substantial cost reduction/avoidance and unprecedented zero defect products (tanks, aircraft, test stations) for the customers.

PRODUCTIVITY IMPROVEMENT


GENERAL DYNAMICS CORP., SPACE SYSTEMS DIVISION

Atlas Fuel Mandrels - \$7.9 Million Savings. A change in welding processes to friction welding has resulted in a \$7.9 million cost avoidance over the foreseeable program life.

Welding of the 6061 aluminum alloy mandrels had been a serious problem for many years. Each mandrel has two circumferential butt welds, 1-1/8" diameter, 3/16" wall thickness. A surface pore of 0.002" diameter after machining is rejectable. The mandrels were originally welded with the manual gas tungsten arc process. This was later changed to electron beam welding with slight improvement. Scrap rates were high. The Welding and Brazing Technology group in trying to improve productivity of this part, theorized that friction welding would be a potential process improvement.

A team effort was organized to prove out this theory. The three team members were: 1) GD Welding and Brazing Technology group in San Diego, 2) Edison Welding Institute in Columbus, Ohio (GD is a member) and 3) the Welding Institute in Cambridge, England. Aluminum bar stock of 6061 and 2219 alloys, machined to simulate the production parts, were sent to England for friction welding.

The weldments were returned to San Diego for evaluation. Both alloys were more than satisfactory. Therefore, a change from 6061 was not warranted. The results were so good that a local vendor was found to do the production. This vendor was facilitated for inertia friction welding. Both variations of the friction welding process were thoroughly evaluated and found satisfactory. A detailed report was issued. To date, over 30 production parts have been welded (60 welds) without a reject. This project was completed in 90 days, from conception to implementation.



Machine Friction Welded
Mandrel from Interface Welding

GENERAL ELECTRIC COMPANY
SPACE SYSTEMS DIVISION
Valley Forge Space Center
P.O. Box 8555
Philadelphia, PA 19101

Contact Point:
Richard A. Walsh
Room M-3041
Telephone: (215) 354-4165

RESULTS OF KEY PRODUCTIVITY/QUALITY INITIATIVES

Space Systems Division has an "Under One Banner" Top Quality/Productivity program focused on incorporating numerous activities; e.g., communications, participation and recognition, organization, micro Q/P projects, health costs/absenteeism, education/training and customer/supplier involvement into one broad-based pervasive program.

Measurable programs include:

CAE/CADMIS/CADMAT emphasizing interactive special networking, tailored higher language software, and laser simulation of circuit designs to generate: automated designs, test plans and procedures eliminating labor intensive engineering operations and most development hardware requirements; automated component and system testing reducing test cycles and crews, and 80,000 lines of test codes, while increasing reliability; robotic and laser applications to automate work stations with an 80% reduction in labor intensive tasks, gaining repeatable precision operations and net reductions in scrap, rework and repair.

OFFICE AUTOMATION with special emphasis on off-peak use of mainframes, and higher level languages improved overall utilization by 9%; innovative software improved mainframe response to remote terminals by 62%, and increased data handling rate nine times and page rate/employee two times. Additional software productivity gains through training, standardization and automation shortened software development, helped retain critical skills, and resulted in a 20% reduction in development costs, and doubling the lines of code produced.

ORGANIZATIONAL EFFICIENCY with application of work analysis tools resulted in elimination of over 200 management positions and increasing manager/worker ratios from 1:6 to 1:10. Staff positions were reduced from 2.6% to 1.9% while the Division grew by 40%.

HEALTH COST CONTAINMENT in 1984-1985 showed hospital admissions down over 8% and length of stay decreased over 6%; although area hospital costs increased 11%, SSD experienced only 5%; 1985 data will show continued improvements from a proactive program which includes a 35% increase in perfect attendance.

Non-quantitative programs include --

ANNUAL QUALITY/PRODUCTIVITY ATTITUDE SURVEY yielding first line data to drive improvements and new initiatives. Over 80% response, of these, 90% favorably perceive management's striving for improved quality/productivity.

EMPLOYEE RECOGNITIONS touched over 1700 people in 1985, 20% of the population.

CUSTOMER INVOLVEMENT in a monthly TQ/P speakers program which averages a 600-person audience with a total audience over 15,000 for a two-year program; recent speakers included NASA and Air Force personnel.

In summary, a sound program ... one we are continually improving!

GOODYEAR AEROSPACE

CORPORATION

AKRON, OHIO 44315

Subject: Key Productivity Initiatives

The Goodyear Aerospace Corporation initiated a Commitment to Perfection, CTP, strategy in January, 1985 to achieve perfection in every product designed, in every product manufactured, in every job performed; and also, to achieve that perfection up front, by doing it right the first time.

The following is a brief outline of the major thrusts of the CTP philosophy in the manufacturing, engineering, procurement and quality organizations.

Manufacturing:

- Employee involvement
- Management, staff, operator training
- Manufacturing Engineering input in all new Engineering designs prior to release
- Process improvement projects
- Statistical Process Control
- Safety

CTP...Engineering Goals

- Innovative Independent Research and Development
- Winning Proposal Writing
- Perfect Contract Execution
- The right Customer Support at the right time
- Total Professionalism

CTP in Procurement

- Certified Supplier System
- System Contract Purchasing
 - Materials ordered as needed - deliver directly to user
 - On time delivery
 - Suppliers compete on basis of quality, delivery performance, and price

CTP and Quality

- Measure cost of quality at Goodyear Aerospace
- Establish goals for reducing cost of quality
- Plan and follow-up needed to meet CTP goals

Grumman Corporation

Bethpage, New York 11714

OVERVIEW: GRUMMAN'S RECENT PRODUCTIVITY/QUALITY IMPROVEMENTS

Productivity Focal Point: E.G. Siebert, Director of Productivity (516) 575-3134

- o People - Since its founding, Grumman has recognized the "people" aspect of productivity and quality. Our benefits and quality-of-work-life programs help us maintain the lowest turnover rate in the industry. A knowledgeable, trained person with his 50% stake in the company (employee stock ownership) has an incentive for productive work.
- o Computer Systems - Dramatic increase in all areas of the company. Beneficial effect on operations incalculable with respect to design, quality, manufacturing, inventory management, flight testing, management, administration, etc.
- o Office Automation - Heavy investment in local word processing facilitated by continuous training sessions for new operators. Today's emphasis on professional productivity.
- o CAD/CAM - Designs, tooling info, and machine parts data currently being produced. Parts programming, N/C machining and supporting business systems operational. In process are DNC, 3-D interactive design systems, and supporting operational systems. Eventual goal total integration of all systems.
- o Factory - Systematically revitalizing manufacturing capability. Included are new skin mills, parts makers and presses, DNC machinery, automated storage and retrieval systems, integrated heat treating capability and robots. Regrouping of production areas into more efficient patterns. Well into 5-year plan for technological and physical modernization. Actual benefit, payback and ROI monitored by management investment tracking system.
- o Quality Improvement - Computerized Quality Information Management System, designed to automate/standardize inspection instructions and identify problem parts, sellers work centers and machine problems.
- o Management Training - Training seminars based on report of NASA's 1984 Symposium on Quality and Productivity.
- o Supplier Involvement - Joint Grumman/supplier seminars to share productivity info and facilitate interface.



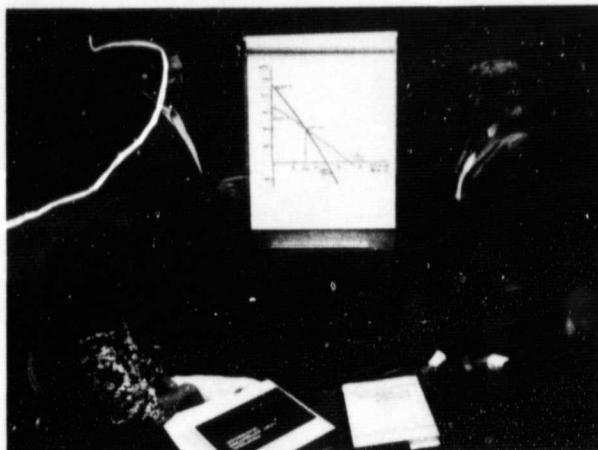
GRUMMAN CORPORATION

Reproduced from
best available copy.

Harris



is setting the pace in performance breakthroughs...



PEOPLE - Harris Corporation's Government Systems Sector is making significant improvements in productivity and quality through the PEOPLE Program

Harris Corporation's Government Systems Sector produces custom communication and information processing equipment and systems for Government agencies and commercial customers. An intrinsic part of achieving the goals of maintaining a competitive edge and ensuring customer satisfaction is continuous productivity improvement and quality enhancement. These goals are achieved through an action plan entitled the PEOPLE Program.

The PEOPLE Program, which stands for Performance Excellence: Our People Lead the Effort, represents management's total commitment to a long-term plan for continuous performance improvement. The program consists of five key elements.

1) Management Leadership: Management directs activities that address systemic issues and clears the way for the introduction of new and improved policies, procedures, processes, and practices.

2) Improvement Teams: System Improvement Teams and Employee Involvement Teams employ

the collective intelligence of all people to make improvements. A structured approach for identifying and solving problems is applied using the continuous improvement model and diagnostic techniques for each step of the process.

3) Training: All employees receive training in program principles and diagnostic techniques such as basic problem-solving, team building, group dynamics, and statistical methods.

4) Measurement: Commitment to excellence means establishing measurable goals for continuous improvement - from individual performance up through all organizational levels.

**PEOPLE PROGRAM
CONTINUOUS
IMPROVEMENT
MODEL**

I IDENTIFY—Improvement Project
D EFINE—Problem, Process and Project Plan
E XAMINE—Symptoms for Underlying Causes
A NALYZE—Data and Develop Solutions
S ELECT—Best Solution

IN

ACTION

Plan for Implementation and Follow-Up

5) Results: Management steering committees have been formed, and more than 1,200 people have been trained. Numerous improvement projects are in progress across Government Systems Sector and are showing

excellent results. Typically, team efforts have produced a 5:1 cost saving/avoidance versus expense ratio, better than 25 percent productivity improvement, throughput times cut in half, and an order of magnitude improvement in quality.

Frank J. Lewis, senior vice president and sector executive of Government Systems Sector, summarizes the commitment to excellence: "We must be persistent, relentless, and enthusiastic in our pursuit of excellence in every area of our business. As we focus our attention every day on continuous improvement and keep our minds open to new ideas and better ways of doing things, we will be moving closer to our goal-performance that meets all of our customers' needs and expectations."

Performance Excellence: Our People Lead The Effort



2830 LOMITA BOULEVARD • TORRANCE, CALIFORNIA 90505-5101 • U.S.A.
TELEPHONES: (213) 326-8110 • 775-3181

28 April 1986

National Aeronautics and Space Administration
Washington, D.C. 20546

Attention: David R. Braunstein, Director,
NASA Productivity Programs

Subject: Hi-Shear Technology Corp. Productivity
and Quality Initiatives and Results

Focal Point Contact: Harry J. Wilmott, Director,
Quality Assurance & Reliability,
Extension 370

Gentlemen:

Let me assure you that HSTC supports, without equivocation, a commitment to excellence, and the industry's and NASA's need for uncompromising integrity and conforming hardware. HSTC maintains a continuing program of identification and implementation of the many elements contributing to quality and productivity. Many of them are quite obvious, and the results measurable. However, we are particularly pleased with the results achieved from our "GET MAD" program which was conceived by our President, R. L. Lynch, just over three (3) years ago. MAD is a acronym for "Meticulous Attention to Detail", and we developed a bright orange sticker which is utilized on much of the documentation.

The constant message exposure, the bright color, and the concerted, spirited support of the entire Hi-Shear population greatly contributes to the high product quality standard which has earned many, and regular commendations from our customers for shipment of conforming product. As long time suppliers to the space program, we were especially gratified to have one of our employees chosen as a Shuttle Launch honoree for his dedication and commitment to excellence.

We consider this recognition to be directly related to the MAD program, and is truly a reflection of the effort by HSTC personnel to attain higher productivity and quality levels.

A handwritten signature in dark ink, appearing to read "Harry J. Wilmott", is written over a horizontal line.

Harry J. Wilmott,
Director,
Quality Assurance & Reliability

HJW/jd

Four Requirements (and Their Definitions) Needed for Program Success

Capable Motivated Team — This is program, business, and technical leadership; technical skills in the areas of design, production, procurement, and so on; good program control; good vendors and subcontractors; and a quality effort by each team member.

Realistic Program — This covers contract type, technical requirements, schedule, cost feasibility, and risk.

Management Attention and Commitment — This applies to all of our management people. It is assigning and maintaining a competent team, appropriate investment, effective reviews, correct business strategy and, very importantly, a climate of mutual trust.

Good Customer — There are many definitions of a good customer but in essence he must be competent, keep the program sold (it's our job to help also), need our product, maintain an open, trusting relationship with us, and be willing to work our mutual problems.

People: The Foundation for a Successful Program

The *individual* is key. We are a very large organization and as such, people look around and see the masses of people and the immediate feeling is, "Perhaps I don't count." That impression could not be further from the truth. Without people, you can't ship product, you can't ship data, you really don't have a Honeywell. Every individual counts and we ought to make sure that everybody understands that they count. That is one of the program manager's jobs.

Ownership is key. There is a saying that goes "Tell me and I'll forget, show me and I'll remember, let me do it and it will be mine." There is really not too much else that we could say that would better explain the importance of developing ownership of the program by the people working the program. Participative management is key to getting ownership.

Quality of Work, meaning the degree to which the work output meets the requirements. This perhaps can be better stated as "doing it right the first time." As knowledge workers, we take an input from some other person, we apply our expertise to it, and we pass it on to another person. That cycle is repeated time after time. It's not hard to imagine the ultimate mass confusion and inefficiency that results from not "doing it right the first time."

Quality of Work Life, meaning the degree to which the work environment fosters employee ownership and contribution. We really don't have a better definition of quality of work life because it's different for each person. But a person has to feel good about his or her job. They have to look forward to going to work. One of the program manager's jobs is to recognize the need for each person to have a quality work life.

Four Areas Where We Need to Improve

The studies also revealed that there are four areas we seem to routinely mismanage—even on the relatively successful programs. These are the areas that need improved performance:

Program Baseline Control — Over and over, the program baseline tends to shift without adequate documentation and communication. Program change is a way of life. But the changes must be documented, understood, approved, and recognized by the individual, the team, management, and the customer so that the appropriate reduction or increase in contract scope can be managed.

Risk Assessment/Risk Management — Too often, program risks are identified, taken, and then forgotten. A&D Policy 50, Risk Management, states that to manage your risks you must:

- a. Identify them, write them down, communicate them, and share them.
- b. Develop a firm, trackable plan for managing them.
- c. Yell for help if you think you need it.

The process has three steps:

1. **Risk Assessment** — the act of estimating the risk associated with a particular alternative course of action.
2. **Risk Analysis** — the generation of alternative courses of action for reducing risk.
3. **Risk Management** — the act of combining risk analysis with risk assessment in an iterative cycle to generate a minimum-risk course of action.

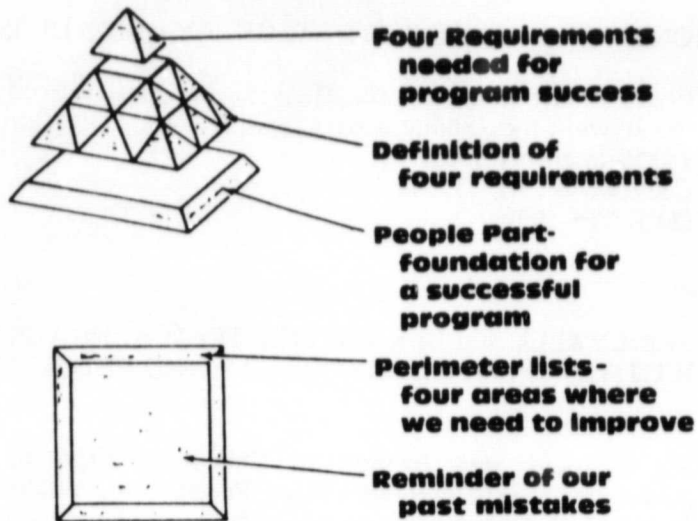
Potential Problem Analysis is a subset of Risk Assessment/Risk Management. Ask the following questions when assessing and analyzing program risks. What could go wrong? What are potential problem sources? How risky is each potential problem? What are possible causes? How can a possible cause be prevented or minimized? How can the most serious potential problems be handled? If you insist on driving your car by looking in your rear view mirror, it's just a matter of time before you will go into the ditch.

Development of common team goals and team building is an area new to many of our operations. Although it takes a lot of time and effort, aligning the goals of the individuals with the goals of the program is important. Each individual must win: he must feel he has something to gain or learn while working on the program. If we find ourselves in a position where the individual goals of the people are at odds with the goals of the program, the program is less likely to succeed.

Reminder of Our Past Sins

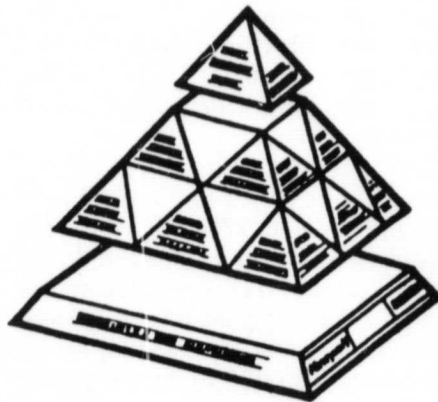
The analyses showed that we were making many of the same mistakes over and over. The repetitive mistakes that were identified include:

- Underestimated technical difficulty
- Overly optimistic assumptions and ground rules during proposal phase (must win)
- Compressed schedule
- Inadequate staffing
- Inexperienced program leadership
- Weak capability and support by technical functional groups
- Inadequate performance of subcontractors and vendors
- Inadequate transitioning from design to production
- Optimistic pricing without allocation of investment



PROGRAM MANAGEMENT GUIDELINES

(WHAT-TO-DO)



Honeywell
AEROSPACE AND DEFENSE

HONEYWELL SPACE & STRATEGIC AVIONICS DIVISION

**Focal Point: Glen Hogan,, Director of Quality/Productivity
Honeywell, Inc./Space & Strategic Avionics Division
13350 Highway 19 S.
Clearwater, FL 33546
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HONEYWELL SOLDERABILITY TEAM ACHIEVES ITS OBJECTIVES OF IMPROVED QUALITY AND PRODUCTIVITY

In April, 1982, a team was formed to find a solution to electronic part solderability problems. Team members from Production, Materials, Engineering, Components Application Engineering, and Product Assurance - thirteen members in all, began the journey of diagnostics to solution. On April 1, 1985, after almost three years of work, a Solderability Team announced that processes and technology now exist in Honeywell's Space and Strategic Avionics Division to facilitate total solderability control.

Two recent events make this claim possible. First, a Robotic component tinning process is now fully operational in the Space Electronics Assembly area and is exceeding all expectations of quality and efficiency. The Robot can process DIPS, flat packs, TO type transistors, and axial leaded part types. Another major accomplishment was the installation of a new gripper that can tin the SSMEC Block II PCB connector.

The second event is the approval, by a major customer, of a newly-developed process for reworking non-solderable parts. The study, completed in 1985, showed that the process works well with no harm to the parts. This new process provides a method for making a majority of non-solderable parts totally acceptable.

During the early phases of the team's work, new technology in the area of solderability testing and part metal finish system evaluation was introduced at SSAvd. The Multicore Solderability tester and UPS X-Ray Fluorescence tester are now used at Electrical Receiving Inspection to test incoming parts, and to control and evaluate the Robot tinning process.

The improvements in the quality of printed wiring board soldering in the area of Space Operations has been a dramatic 78%. For the final quarter of 1985, there were only 6 dewetting defects out of an estimated 100,000 solder joints. Equally impressive were the gains in productivity with the Robot process over the old manual process. The average cost per part of the manual hand-dip process was 60 cents, now with the Robot, the cost is 4 cents. Quality and Productivity savings from this team project amount to 160,000 dollars a year.

Honeywell

HR TEXTRON

HR Textron Inc.
a Subsidiary of Textron Inc.

25200 West Rye Canyon Road
Valencia, Calif. 91355
805/259-4030

TWX 910/336/1438 TELEX 65/1492
LRS-HAS-86-6866

Subject: HR Textron Inc. Productivity Initiatives

HR Textron Inc. has continually strived to find new methods for improving productivity of our many products and especially the Space Shuttle Main Engine Hydraulic Actuators. All changes on the Shuttle program require an approval from our Customer, Rocket-dyne and NASA.

An engineering change was submitted and approved for the servo-valve and servoswitch in late 1985. This change improved the productivity and reliability of these components and greatly reduced rework time for each component.

This change covered the method of retaining the internal in-line filter found in the first stage of the servovalve and servoswitch assemblies. The original retention utilized one steel ball at each end of the filter. The insertion of the balls into each end of the cavity for retention and leakage prevention, often caused distortion of the cavity. This effected the stability of the torque motor assembly which necessitated the rebuilding of the valve. The new method of retention utilizes a plug and o'ring seal at each end of the filter. This method has eliminated the distortion problem and improved the "no leakage" requirement. At the same time all build and test procedures were reviewed and up-graded to enhance producibility.

HR Textron Inc. as a valued supplier to NASA, will implement productivity initiatives in all phases of their manufacturing and engineering as these changes are identified.

THE HUGHES AIRCRAFT COMPANY



Quality is our number one operating priority. We will achieve superior quality in our products by adhering to the following principles:

- *The ultimate measure of the quality of our products is the degree to which they satisfy the needs of our customers.*
- *No operating decision will be allowed to impact negatively the quality of our products and operations.*
- *In all of our activities, we will concentrate on error and defect prevention through care in work performance and control of equipment and processes, as contrasted with subsequent error and defect correction.*
- *Total Quality will be applied universally. It is the obligation of each employee to strive for error-free performance of his/her portion of our total task. It is the obligation of management to provide systems and training so each employee can perform to his/her highest capability.*

KEY PRODUCTIVITY AND QUALITY INITIATIVES

IBM

COMPANY:

Federal Systems Division
IBM Corporation

FOCAL POINT:

Louis Sportelli
6600 Rockledge Drive
Bethesda, MD 20817
(301) 493-1418

The Federal Systems Division (FSD) of the IBM Corporation has been actively involved in an intensive quality and productivity improvement effort since 1980. Mr. Louis Sportelli, the FSD Director of Quality, has the overall responsibility for the planning and direction of these activities. FSD Executive Management (President, Vice Presidents and General Managers) have been responsible for the implementation of the program. Quality Councils, composed of top level management at FSD Headquarters and each of the Division locations, provide the control, guidance, and coordination of improvement activities within their respective organizations.

The prime objective of FSD's Quality Improvement Program is to provide defect-free products and services, on time and at the lowest cost. The improvement efforts over the past six years have made many significant contributions toward reducing operating costs, improving product quality, and increasing the efficiency of the business processes.

FSD's focus for improvement has been two-fold - people and processes.

All managers have received training in quality improvement methods, participative management, process management, and defect prevention and problem solving techniques. Over 95% of all personnel have been given training in those techniques needed to address and solve problems in their individual work environments. Approximately 800 Quality Improvement Teams were active in 1985 with over 5000 employees participating. A total of 719 team members received formal recognition for their contribution to the program.

Emphasis on business processes has been a major objective of FSD to improve efficiency and effectiveness. Quality Improvement Teams have been addressing process improvements in their areas of responsibility. As part of a Corporate-wide initiative, FSD implemented a Quality Focus on the Business Processes. Sixteen major processes within the Division were selected for analysis and improvement. These selected processes cover all of FSD's major business activities, including finance, accounting, contracts, program management, marketing, engineering, software development, manufacturing, procurement, and field support. A total of 177 subprocesses that make up these 16 processes have been documented, analyzed, and rated. Major improvement opportunities in each process/subprocess have been identified and improvement action plans have been developed and are being implemented.

The focus on the business processes has so far resulted in a major reduction and simplification of the business control and operating procedures, expansion of automation applications, development and implementation of new structured hardware design techniques, improvement in the quality of delivered software, reduction in various subprocess cycle times and defect rates, and enhancements to the quality of documents being processed.

Klate Holt Company
P. O. Box 668
Langley AFB, VA 23665

Langley Research Center

Logistics and Administrative
Support Services
Contract NAS1-18150

Steve Miller, Contract Manager
804 865-3555

Productivity Accomplishment

The contract Supervisor of the Engineering Drawing Files (EDF) section, within the Logistics and Administrative Support Services contract at Langley Research Center, recommended to the Klate Holt Company and her Contract Monitor the possibility of improved productivity if the EDF Indexing was changed from a keypunch card (tab) system to an on-line input system. Her recommendation was put to the test and the before-and-after impact on productivity follows:

Previously the tab card would be keypunched and forwarded to Analysis and Computation Division (ACD); a batched job to be compared against the master indexing tape. After this process was accomplished several times (being sent back to EDF and back to ACD for editing each time), the batch would be updated and aperture cards generated. At a minimum this would be a three week process.

Under the new process, drawings are entered as they are received into computer files. As a batch is completed, the input information is electronically transmitted to be compared against the master index. One edit is performed, then the batch is updated and aperture cards generated. The improved system of processing resulted in a savings of 125 man-hours per month in manual review and travel time. Further, as an indirect result, one man-year of effort was saved on the Civil Service staff and more effectively utilized in another Management Services Division (MSD) branch.

KLATE HOLT COMPANY

P.O. BOX 668, LANGLEY AFB, VA 23665



LTV AEROSPACE & DEFENSE COMPANY VOUGHT AERO PRODUCTS DIVISION

LTV Aerospace and Defense Company's Vought Aero Products Division (VAPD) achieved a 5.6 percent total Factor productivity improvement during 1985. The result highlighted the Division's two-track approach towards productivity and quality improvement. The objective of the productivity program is to unify productivity objectives with all on-going operations of the division. The quality program supports a strategy of continuous improvement through teamwork, at all levels.

Productivity Improvement Program. VAPD has implemented a comprehensive productivity improvement program that operates at different levels of business activity from the total corporation down through the unit level. The program assimilates the productivity improvement theme in the routine operations of the company by focusing on the following top-down process.

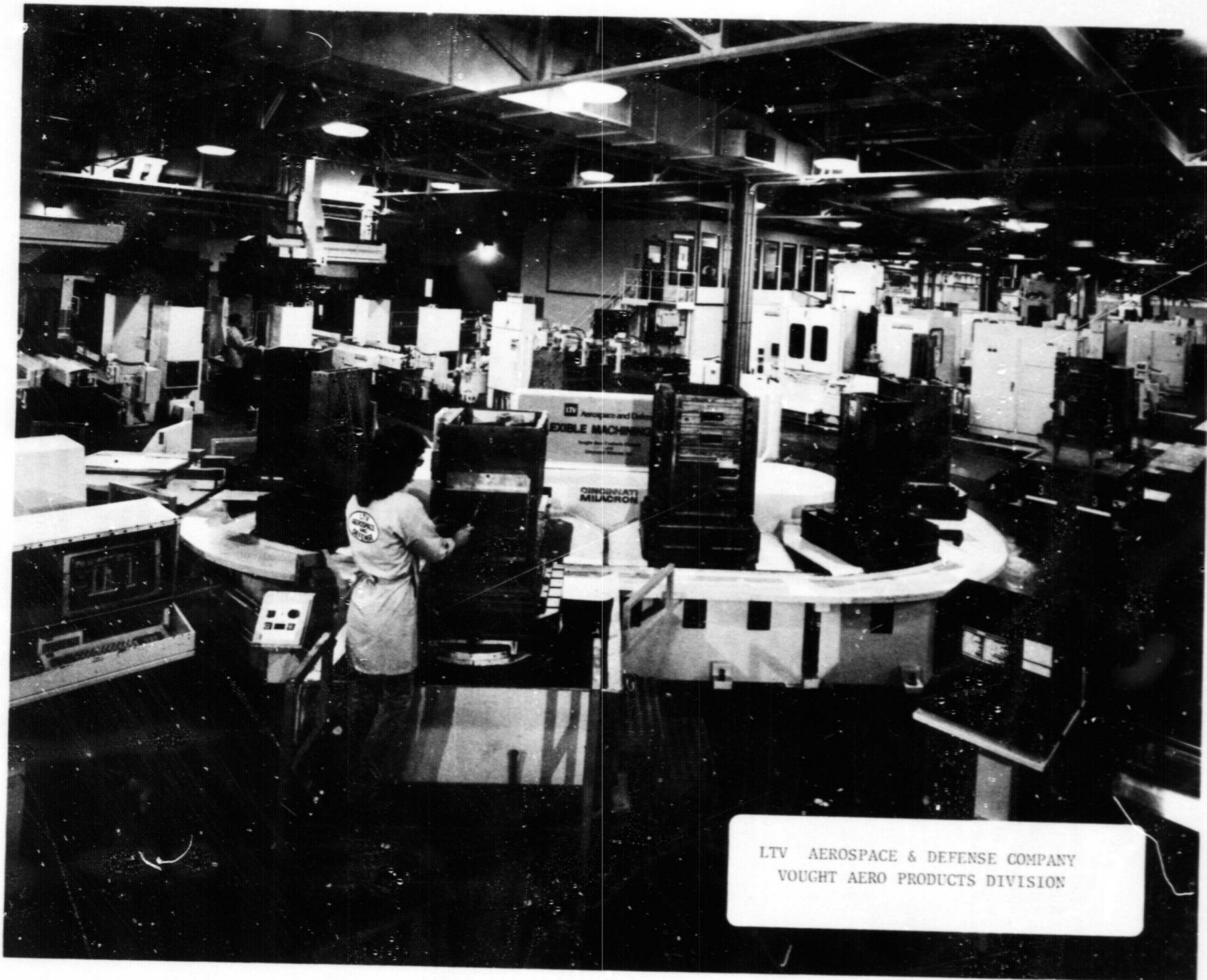
1. **Strategic Plan:** Establish competitive productivity targets.
2. **Development Plan:** Select projects with employee participation.
3. **Budgets:** Synchronize budgets with productivity targets.
4. **Operations:** Use measurements to monitor performance.
5. **Profits:** Share savings with customer to reduce acquisition costs and enhance profits.

The program is based on a realization that progressive improvements in manufacturing technology have modified the cost structure of aerospace contractors. The cost drivers have shifted from production to the support and overhead areas. Therefore, in the context of total modernization of a company, a limited focus on manufacturing is insufficient. Recognizing the need to broaden the productivity goals, VAPD is implementing a wide-range of modernization initiatives which include: office technology modernization, computer integrated engineering, automated procurement, employee badge based automation, artificial intelligence in bids and proposals, energy management system, automated warehousing and, of course, flexible manufacturing systems. The cited projects are a small selection from the wide range of modernization initiatives being taken at Vought Aero Products Division. They, never the less, demonstrate that it is feasible to simultaneously address all facets of company costs.

Quality Improvement Program. In keeping with its strategic goals for enhanced product quality and improved productivity, VAPD has formally adopted a policy of "excellence" at the executive management level. The policy is to "promote pride and excellence in each employee's performance and to deliver products and services which conform to the requirements of our customers." It implies a strategy of continuous improvement through teamwork. An Executive Steering Committee directs the overall process of emphasizing the principles for excellence. The Steering Committee has established a Quality Improvement Council with the responsibility to assist management in coordinating, planning and implementing improvements in the quality of operations throughout the division. To meet this challenge, the Quality Improvement Council is taking the following actions:

- o Implementing a division-wide quality training program.
- o Organizing participative projects teams to solve chronic problems.
- o Developing a Cost-of-Quality reporting system.
- o Communicating results of the effort to all employees.

The program recognizes that achieving improvements through the excellence process requires participation, involvement, and teamwork at all levels.



LTV AEROSPACE & DEFENSE COMPANY
VOUGHT AERO PRODUCTS DIVISION

Fred C. Sheffey - Director
Administration & Program Support
P.O. Box 650003
Dallas, TX 75265-0003

**LTV AEROSPACE & DEFENSE COMPANY
VOUGHT MISSILES & ADVANCED PROGRAMS DIVISION**

**PRODUCTIVITY IMPROVEMENT PROGRAM
PRODUCTIVITY WITH QUALITY**

The Productivity Council chaired by Fred Sheffey has the oversight of the Productivity Improvement Program at Vought Missiles and Advanced Programs Division. The Council, comprised of eight senior executives from all functional and business areas of the Division, is a dynamic and active organization which is empowered to review any area or activity to determine where improvements in the processes or procedures can be made. When additional investigations are required, the Council appoints a Productivity Involvement Committee of appropriate managers and/or employees to perform essential research and to present findings and recommendations. Twenty-four such topics have been identified and rank ordered for study. Ten Productivity Involvement Committees are either currently involved in a study or have completed their research and made recommendations to the Council.

The study on office automation resulted in establishment of the Office Productivity Program. Results from a pilot program were so positive that a trial network is being installed in the Finance and Human Resources Departments. A steering committee has the oversight of the expansion of this program into other departments over the next five years.

A number of other significant accomplishments have been realized since early 1984 when the Productivity Improvement Program got under full swing. The Employee Productivity Involvement Program has generated 621 suggestions to effect cost savings or quality or safety improvements. Of these, fifty-nine have been implemented for a cost savings of nearly \$500,000. Twenty-nine thousand dollars has been awarded to the suggesters. This year the program has shown a forty percent increase in participation over last year.

The Productivity Improvement Report documents cost savings that result from good management decisions or activities. Each year since its inception cost savings of over a million dollars have been reported.

Participative management is sponsored through communication groups in the Operations Department and through Performance Action Teams in other departments. This increased involvement has resulted in better morale and team spirit and seems to be at least partly responsible for the increase in the number of suggestions submitted.

Performance measurement was begun last year in a low key way with each director selecting one or two key performance indicators. The MAPD Productivity Measurement System has now been developed and is in the first stages of implementation. In this plan the Performance Action Teams (work groups) select and rank order five Key Performance Indicators for measurement of their crucial activities or services. It is expected this system will be implemented throughout the Division by mid 1987.

To publicize all these programs a newsletter "Getting Involved" is published bimonthly and mailed to each employee. Productivity improvement is being incorporated in planned stages as an integral and permanent part of VMAPD's corporate life.

Getting involved

A Productivity Newsletter

VOLUME NINE MARCH 1986

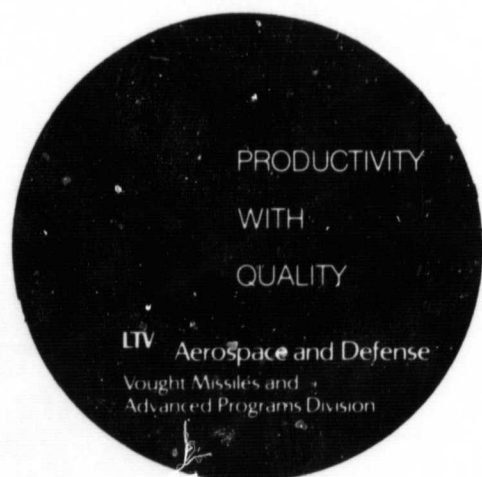
To Improve Productivity

The following tips were submitted by our anonymous writer.

I am sure that most of you have established performance goals for your organization and your own personal development goals for 1986. I hope the goals you set are attainable and reasonable, and yet challenging enough to motivate you and give you a feeling of real accomplishment when they are reached. The goals should be used, not buried six feet down and disinterred at the next annual performance review session.

Your next major step after establishing your goals is to plan how you will attain them. Many people operate on the assumption that setting deadlines for getting things done is tantamount to having a plan – they are wrong! Planning is a conscious process of selecting and developing the best course of action and program to accomplish an objective. So here are some planning tips for you.

1. Ensure that all affected organizations and individuals are involved in the planning.
2. Base plans on an analysis of the available facts and the application of experience and judgment.
3. Quantize plans whenever possible.
4. Examine all pertinent trade-offs.
5. Develop contingency plans well in advance of potential events that may have an effect on them.
6. Examine plans critically before implementing them.
7. Recognize that organizational plans can only succeed if they are communicated effectively, are understood, and are properly carried out.
8. Be flexible enough to seize opportunities (not in the plan) which will materially assist in reaching the desired objective.



COLORFUL LOGO CARRIES A POWERFUL MESSAGE

Fred Sheffey, Chairman of the Productivity Council, was asked the question, "Why was this logo chosen for Productivity?" Here is his response.

Even though this may be your first introduction to our logo, it was selected by the Productivity Council in December 1984 and made its low-key appearance. The plan was for it to become part of the long-range productivity program as described in a *Profile* article dated December 1983 and not a short-term fad or gimmick. Now we feel free to tell a few things about why it was selected over many other entrants.

Productivity with Quality

First of all, it contains the words, "Productivity with Quality." As you know, any productivity improvement is for naught if the output doesn't meet the requirements (quality). Secondly, it identifies our division, our company, Aerospace and Defense, and our affiliation with the parent corporation, LTV.

Teamwork for Success

Additionally, the logo is in the form of a circle, which indicates no loose ends, no special place for anyone – with teamwork we will accomplish our objectives. The yellow stairs on the logo demonstrate that the team must mount ever-higher levels of performance to succeed.

Every Day Brings New Opportunities

Finally, the red-orange glow at the top symbolizes the sun rising on a continuous new day of enlightened examination of our processes and discovery of new opportunities for success. We do not want the message of our logo to be a short-term fad as was recently described in an article in *Business Week*, but rather to be institutionalized and made an integral part of our company lifestyle and culture.

Logo Available

The logo has been placed on tags for briefcases and suitcases. It appears on the cover of the October 1985 issue of the *Productivity Improvement Program Plan*, and on all the suggestion boxes throughout the facility. We have a sticky-back version for use on notebooks, documents and other appropriate items. While all aspects of our logo are important, the most significant and long-range consideration to be remembered is – **PRODUCTIVITY WITH QUALITY.**

PRODUCTIVITY AND QUALITY INITIATIVES FOR NASA BOOKLET

Contact: Rob Searson

During the past year Life Systems has been quite successful in its efforts to improve quality and productivity. The company established a formal Productivity Improvement and Quality Enhancement (PIQE) Program to better assure the company's philosophy on productivity and quality was effectively communicated and implemented throughout the organization. Responsibility for coordinating PIQE activities has been assigned to specific individuals within management. Most of our PIQE activities are performed within discrete projects, which are planned, scheduled, budgeted and monitored by the program coordinators, in accordance with a written PIQE Program Plan.

Life Systems continued its progress in automating many of its management systems under the PIQE Program. One new automated system is the Program Status Analysis, which provides overall and task-level schedule and budget information for each active contract program. These reports form the basis for monthly program reviews between program managers and upper management. This system has proved to be particularly useful for the early identification and correction of schedule or cost problems.

The company also began automating its accounting systems as it moves toward an integrated Financial Control System. The payroll and labor reporting systems are fully operational, with accounts payable and general ledger to follow shortly.

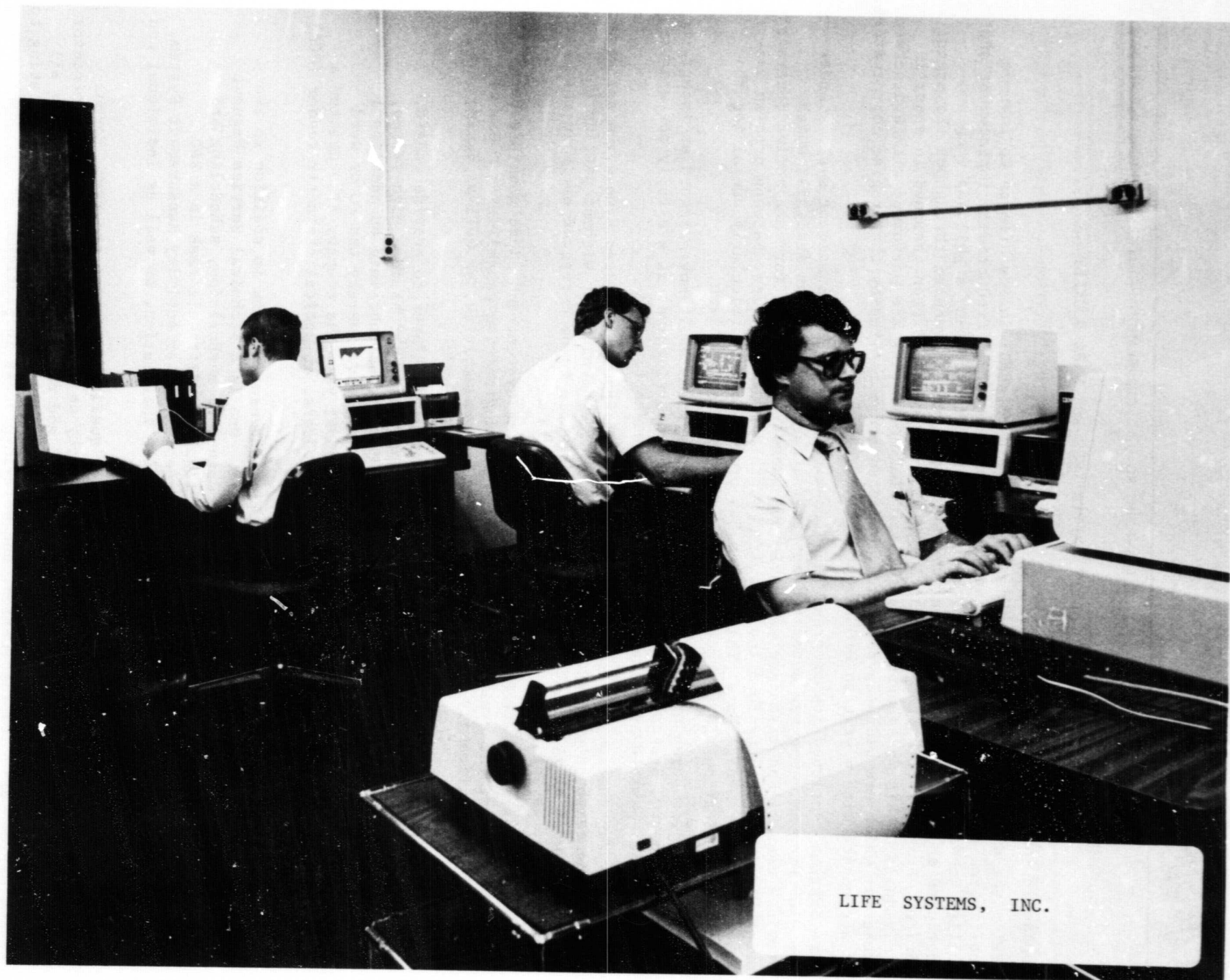
This past year the company completed development of special PC-based simulation software for testing components, assemblies and systems under development without putting the actual hardware at risk. Identified problems are able to be corrected early in the design stage, saving time and money.

Just over a year ago Life Systems obtained a CAD/CAE system, and since then has been phasing in use of the system's various design and engineering capabilities. Use of CAD/CAE has significantly improved design drawing productivity, as well as design quality.

Obtaining CAD/CAE was part of the company's continuing efforts to provide modern, efficient equipment for its employees. The company also purchased a high-volume, high-speed photocopier for the Word Processing Center, and obtained an additional half-dozen personal computers. The company now has approximately one PC or word processor for each three employees. During the past year the company also created a communication network that links PCs, word processors, an optical character reader (OCR) and automated typesetting equipment.

Life Systems implemented several other work measurement systems in addition to the Program Status Analysis system mentioned above. One is a Technical Service Request system, which has proved to be an effective method of authorizing, scheduling and monitoring technical work assignments, a particularly difficult task in a R&D environment. Another system is the Word Processing Center Activity Measurement System, which provides department throughput and capacity information, as well as individual and department productivity measurements.

The company has also improved its subcontractor quality assurance program. Formal guidelines, which present the company's philosophy on quality and outlines subcontractor quality assurance requirements, were distributed and are included by reference in all applicable subcontracts. This augments our other vendor interfaces, including meeting to review designs prior to fabrication, and work-in-process inspections.



LIFE SYSTEMS, INC.

The Lockheed Engineering and Management Services Company (Lockheed-EMSCO) was formed in 1980 as a spinoff from the Lockheed Electronics Company. In 1981 a productivity enhancement program was initiated to support the company's commitment to being the technical services industry performance leader. It's noteworthy that the beginning Lockheed-EMSCO performance was already very good so the program was pointed at achieving leadership rather than correcting problems.

The principal thrusts of the program initially were two-fold; encouraging free and open communication between employees and management and fostering an attitude of empowering employees on the part of management. To do this, two programs were started simultaneously, a bottom-up program stressing communication and a top-down program stressing empowerment of employees.

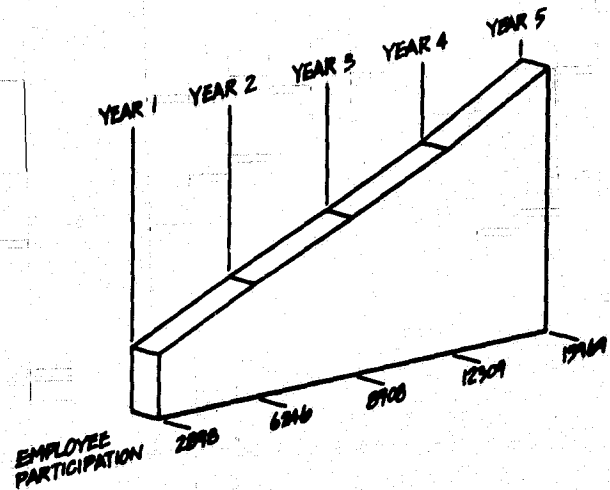
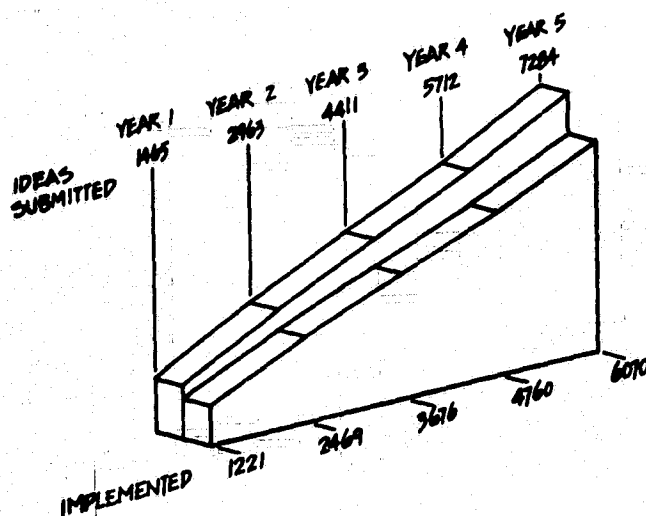
The bottom-up program began with an employee attitude survey the results of which were briefed to all employees in groups of approximately 40 each. Employees who had strong views on any perceived deficiency in environment or process were invited to form ad hoc teams to propose corrective action to management. Several team projects were undertaken and those ad hoc teams became the forerunner of a continuing employee team program. In addition to these employee initiated interactions with management, skip level meetings which skipped one or more levels of management were conducted to provide employees a broader based view of the intent and purpose of organization objectives and actions.

The top-down program involved training management and supervision to recognize that performance of employees is greatly improved by adjusting the degree of supervisory involvement to suit the employees' willingness and ability to perform the task assigned, the bottom line being that supervisory requirements vary by employee and task rather than merely by employee. Said another way, categorization of employees as excellent, average, and poor is recognized as shortsighted and an oversimplification of what people's capabilities are.

In 1983 an organization culture change project was begun to promote a more proactive or entrepreneurial culture. The project led to creation of an innovative leadership development program as a means to enable individuals to develop proactive behavior. Rather than focusing on techniques, the program emphasizes ways of being relative to people, circumstances, possibilities, and action. The program mixes management and non-management personnel at all levels and has been conducted with groups ranging from 20 to over 100. Participation is voluntary and is done mostly on employees' own time. Results have exceeded expectations and surpass effectiveness of other training programs conducted over the past 20 years.

Specific results produced (as observed) include initiation of numerous productivity projects, joint company/customer projects, an employee administered suggestion system, an employee promoted wellness program including exercise facilities, and a bargaining unit supported automation project. Results produced (as reported by participants) include more open communication on and off the job, more cooperation between organizations, willingness to work with people previously avoided, and employees proposing projects to enhance performance rather than complaining about circumstances, customers or management.

CONTACT: Mr. Robert L. Vaughn, Director of Productivity
O/10-04, B/101 Tel. (408) 742-6043



LMSC views improved productivity-quality as a total company-wide commitment. As a company directly serving our nation's defense interests, LMSC recognizes how crucial it is to develop greater strength through increased productivity-quality. Increasing productivity-quality provides one of the rare "win/win" situations in which everyone gains - nations, present and future populations, stockholders, management, and employees.

The LMSC Productivity Program is based upon the input of motivated people. LMSC employees comprise one of the most talented pools of people in the nation, and it is through their creative contributions that LMSC maintains superior product quality. Increasing those contributions is LMSC's most integral productivity-quality initiative. Therein lies the key to improved productivity-quality.

LMSC's 80% approved suggestion and implementation rate is unparalleled in the industry and it continues to rise on an annual basis. Current efforts are directed at integrating Product and Quality Assurance organizations as well as suppliers and sub-contractors as part of the Productivity-Quality Network.

Productivity ideas and suggestions are the backbone of LMSC's Productivity Program. The charts exhibit the dramatic evidence of the success of the program since its inception in 1981. This success can be attributed to the visible involvement of LMSC's senior management and the strength of the organization of the Program. Central to that strength are the "Productivity Thrusts" that permeate strategic planning efforts. Those thrusts are:

- o Productivity-Quality: The Equation for Excellence
- o Improved Planning Processes = Long Term Productivity-Quality Improvement
- o Organization Goals and Objectives: Roadmaps to Success
- o Total Engineering/Manufacturing Interface

FOCAL POINT: S. R. Locke, Director, Productivity (504) 255-2943

OVERVIEW OF PRODUCTIVITY & QUALITY INITIATIVES:

Through the diligent application of our Productivity & Quality initiatives, Martin Marietta Michoud Aerospace has generated significant cost reductions, while delivering every Shuttle External Tank on or ahead of schedule. This productivity and quality process is a continuous and iterative concept of a "Mission Success" culture that is permeated throughout every level of the Martin Marietta organization. The record of building and delivering Shuttle External Tanks of the highest quality, on schedule, while at the same time increasing production rates and reducing both cost and nonconformities can be summarized by the following statistics:

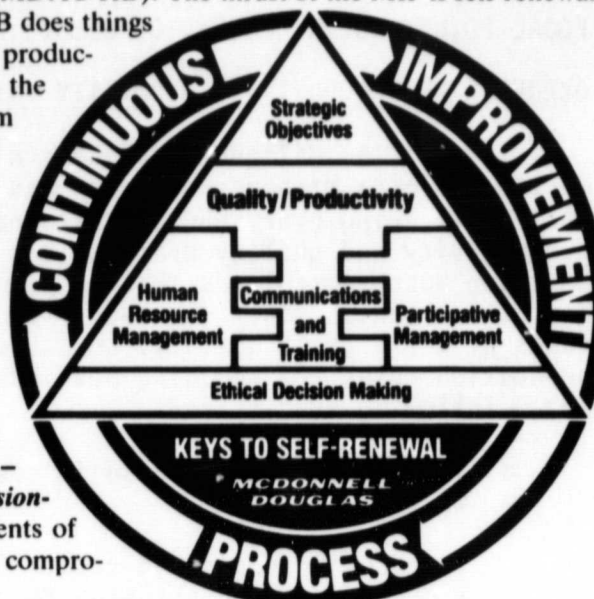
- o Achieved a 45% decrease in cost of 30 production external tanks while:
 - reducing scrap and repair 95% in 30 units.
 - reducing manufacturing touch manhours per External Tank by 53%
 - reducing total support manhours per External Tank by 64%
 - reducing employee turnover rate by 56%
 - reducing the number of union grievances by 35%
 - no product (External Tank) recalls since 1973
 - no lost time accidents in 16.8 million work hours
 - increased savings from employee suggestions by 50%
 - increased awards to minority business by 136%
 - increased skills training for hourly employees by over 900%
 - increased management training by 61%
 - received the 1985 U.S. Senate Productivity Award
 - received the National Safety Council's "Highest" award for safety
 - sole recipient "Award of Excellence" from the International Association of Quality Circles
 - finalist for NASA's Excellence Award for Quality & Productivity
 - "Superior" award fee rating by NASA over the four past years.

Many other examples of Productivity Improvement and Quality enhancement initiatives for facility, energy, and environmental improvements can be cited.

MARTIN MARIETTA

McDonnell Douglas Astronautics Company in Huntington Beach, California.

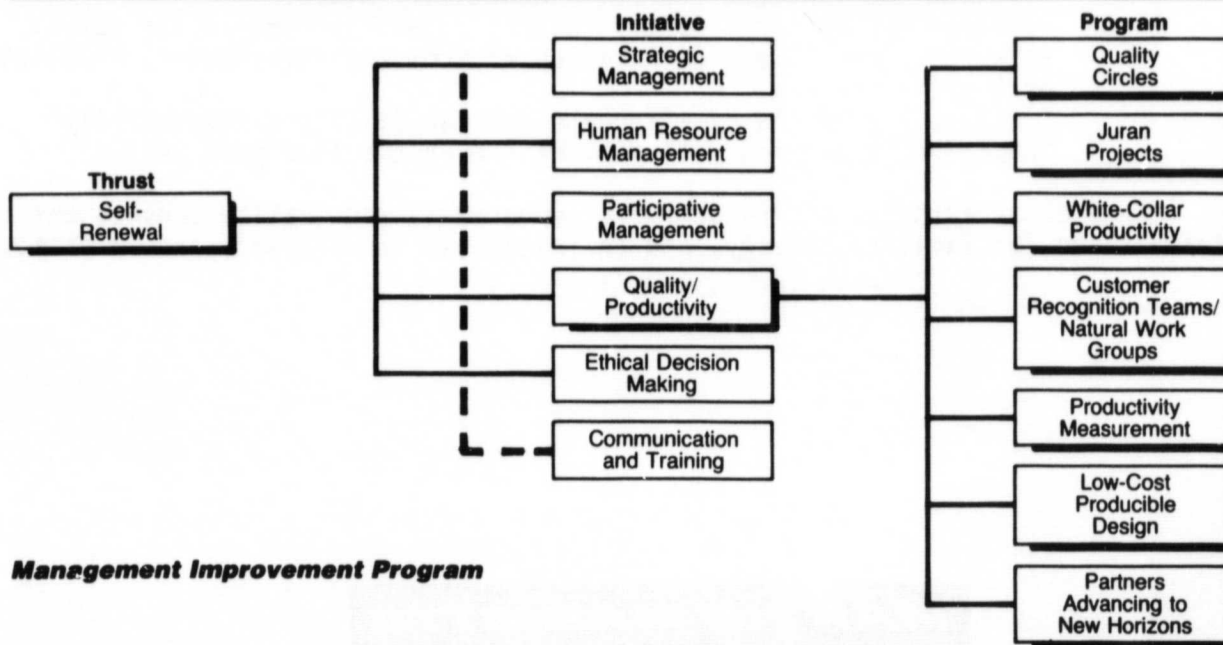
NASA's PIQE program is embodied in the Management Improvement Program (MIP) at McDonnell Douglas Astronautics Company, Huntington Beach (MDAC-HB). The thrust of the MIP is self-renewal, and its ultimate goal is to change the way MDAC-HB does things by developing a company culture that will maximize productivity to benefit not only the corporation but also the individual. Productivity improvement as a long-term strategy is emphasized by McDonnell's Chairman and Chief Executive Officer, Sandy McDonnell, in his five initiatives, the Five Keys to Self-Renewal: (1) **Strategic Management** – knowing where the company wants to go and deciding what is needed to get there, (2) **Human Resource Management** – making use of every available opportunity to help individuals develop their full potential; (3) **Participative Management** – giving every employee a full opportunity to participate in shaping the future of the corporation; (4) **Quality/Productivity** – “Doing it right the first time;” and (5) **Ethical Decision-Making** – setting high ethical standards for all elements of MDAC-HB and making difficult decisions without compromising those standards.



Cornerstones of the MIP are quality circles, Juran Projects, white-collar productivity improvement, and customer recognition teams/natural work groups. The figure below depicts the relationship between the thrust (self-renewal), the initiatives (strategic management, human resource management, participative management, quality/productivity improvement, ethical decision-making, and communication and training), and the programs.

WE ARE . . .

Institutionalizing the self-renewal process to involve all personnel at all levels so that they may have a stake in the decision-making process.



Management Improvement Program



MECHANICAL TECHNOLOGY INCORPORATED

LATHAM, NEW YORK

Mechanical Technology Incorporated is a science-based growth enterprise dedicated to the development of high-technology products. Since its founding in 1961, the Company's instruments, test systems, controls, and components have provided improved productivity, efficiency, and reliability for government and industrial clients. In particular, the Research and Development Division has undertaken several projects which have resulted in productivity increases. The following paragraphs summarize three of these projects with promise of significant future benefit.

The In-Process Control of Machining Program has focused on increasing production rates and product quality in the manufacture of hardware for the U.S. Army. In the first phase of the program, MTI fitted a machining center with an optically-based, microcomputer-controlled system that monitors cannon-recoil assembly components as they are machined, compares them to specifications, and corrects the tool path if necessary.

At an end-of-project demonstration in October, the system was acclaimed as being the first example of a tool being guided by a sensor under real-time control to produce a part in a manufacturing environment. The system cut machining time from 150 to 48 minutes and on-machine inspection time from 120 to 12 minutes while producing parts of unprecedented quality. The program was praised as "the most significant technology modernization program this year".

A second productivity initiative is the multimillion-dollar "Straight Stack" Air Force program, which will increase efficiency in the repair and assembly of military jet engines. After engine rotors are disassembled for overhaul, major components are inspected by a state-of-the-art, electro-optical/laser-gaging system. The critical dimensions are analyzed by computer to determine whether a piece can be restored to service. The objective is to reassemble suitable parts in a preselected sequence that assures minimum vibration in rebuilt engines. Like other programs MTI has undertaken for the Air Force, the contract is expected to result in significant savings for the military in both time and dollars.

A third productivity initiation arose when a major brewing company came to MTI for a system which would perform quality-control inspection of aluminum can ends in a production environment. MTI's unique EndSpectortm system integrates structured-light machine vision techniques and material-handling elements. The inspection system will automatically measure over 20 features on the can-end surface in less than three minutes and will replace labor-intensive inspection that experiences delays of up to 12 hours in identifying defective can ends.

MERCURY
CONSOLIDATED INC
A QUALITY SERVICE COMPANY

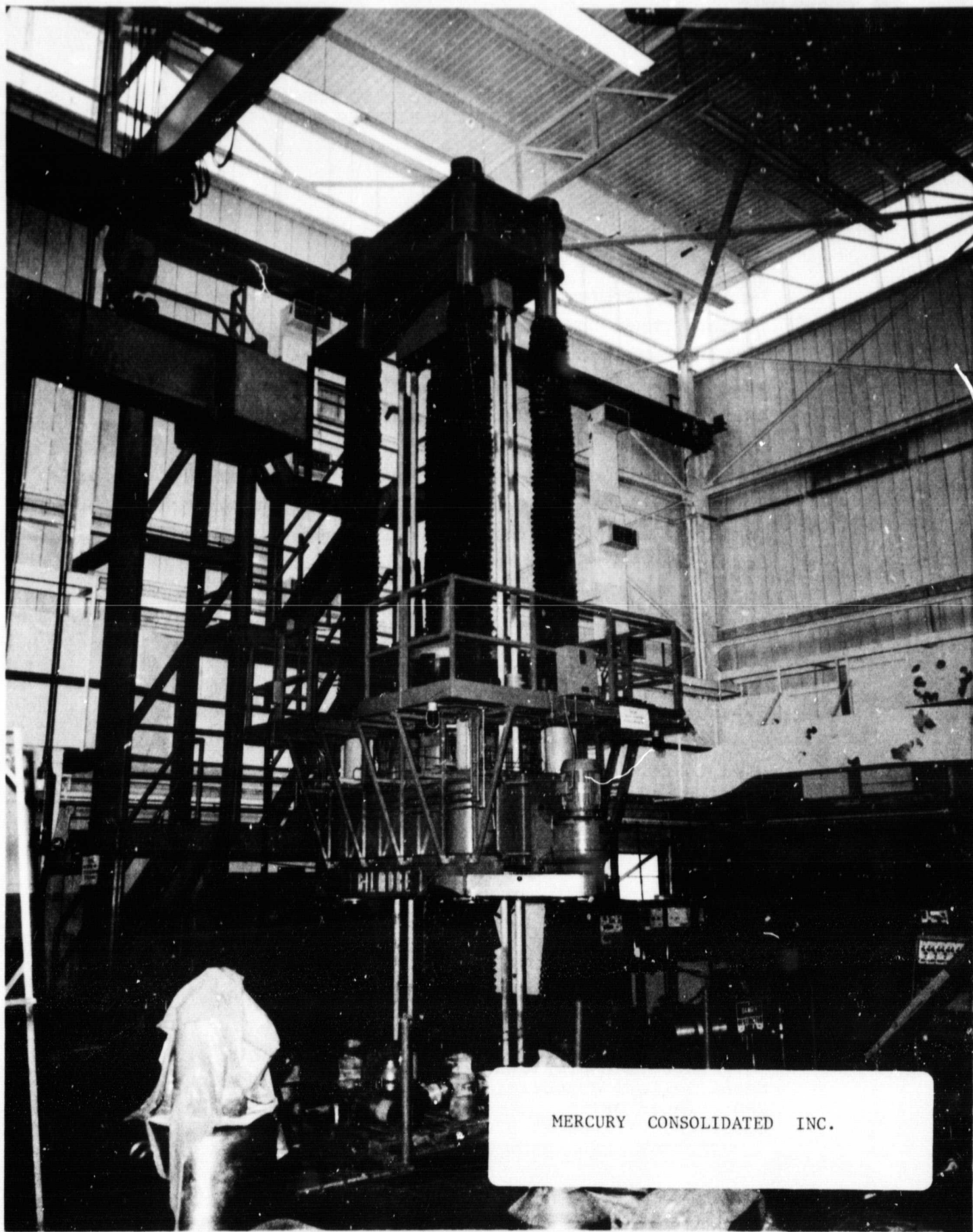
Organization: Mercury Consolidated, Inc.
(Subcontract Operations at MSFC, AL)

Focal Point Individual: Ms. Teddi Malone
Mercury Consolidated, Inc.
P. O. Box 8295
Redstone Arsenal, AL 35808
Phone: (205) 544-4022

PIQE Write-up: PIQE FORCE MACHINE

During the contract year ending on March 31, 1986, electrical refurbishment of the 5,000,000 pound force calibrator got underway. Innovative techniques which are being utilized include computer selection of dead weights, computer control of force level while in the hydraulic force multiplier mode, and automatic data gathering and data reduction for the unit under test. It is anticipated that quality of calibrations will be greatly enhanced due to elimination of errors of transcription and mathematics by the calibrator-technician. Productivity will be improved because of decreased calibration time and elimination of the need for double checking all data by manual methods.

Photo: The enclosed photo provides above ground
(enclosed) view of the Gilmore Force Calibrator highlighted above. Flexures and fixtures are on the floor beneath structure.



MERCURY CONSOLIDATED INC.



SPF REPLACES FORGING FOR PREFORMS FOR A TITANIUM HIGH PRESSURE BOTTLE

MBC is using the superplastic forming process to make two hemisphere preform pieces from 7/16 inch thick titanium plate. These "preform" pieces are then machined to the required wall contours and varying thickness to optimize weight and strength. Then they are electron beam welded to form a sphere used to contain high pressure gas.

The past methods of producing the part were to use a thick (over 1 inch) forging or creep formed piece to machine the hemispheres. This process wasted material and was more costly in the forming process than SPF.

By using SPF a significant cost reduction was obtained in this high pressure titanium bottle.

Superplastic forming is a process where high temperature is used to heat the material, and inert gas under pressure is used to force the "plastic" material into a die cavity.

J. K. Solheim
Corporate Vice President, Manufacturing
Metal Bellows Corporation
200 Science Drive
Moorpark, California 93021-8010

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METAL BELLOWS CORPORATION



Monitor Aerospace Corporation is recognized as a leader in the production of Aerospace structural components and assemblies. We contribute to the success of the Space Shuttle program as well as many other aircraft for both the Commercial and Defense industry.

In an effort to remain a forerunner of our respective industry we are continually seeking better ways to reduce cost and improve the quality of the parts we produce. The following programs contribute to our current success and establish the foundation for future quality orientated growth.

1. **Zero Defects Program** - Encourages all employees to participate in improving the methods by which we operate. By use of an ECR (Error Cause Removal) form, any employee may state a problem they have in accomplishing their job and be assured that they will either see a change instituted or receive an explanation of why a change is not feasible. The president personally reviews the results of all ECRs.
2. **Quality Circles** - Provides a forum within each department to discuss and solve problems as a group. It allows all participants an equal chance to contribute thoughts and decide on the action to be taken to solve a respective problem.
3. **Computer Aided Design / Computer Aided Manufacturing** - Through the development of our CAD/CAM system we are continually improving on both the quality of N.C. tapes and tools utilized to manufacture machined parts as well as reducing the cost and manufacturing lead time required to produce the final product for delivery to our customer.
4. **Digital Automated Inspection** - Our DEA automated inspection machine enables fast and accurate inspection of complex machined part surfaces. It supplies a computer print out of inspection results for review by Quality Control and Manufacturing Engineering. Our future plans include the purchase of a second DEA machine to further this effort.

Northrop Corporation

Productivity and Quality Overview

Northrop recognizes that we exist in an increasingly competitive world. Our corporate focus is based on people being our single most important asset.

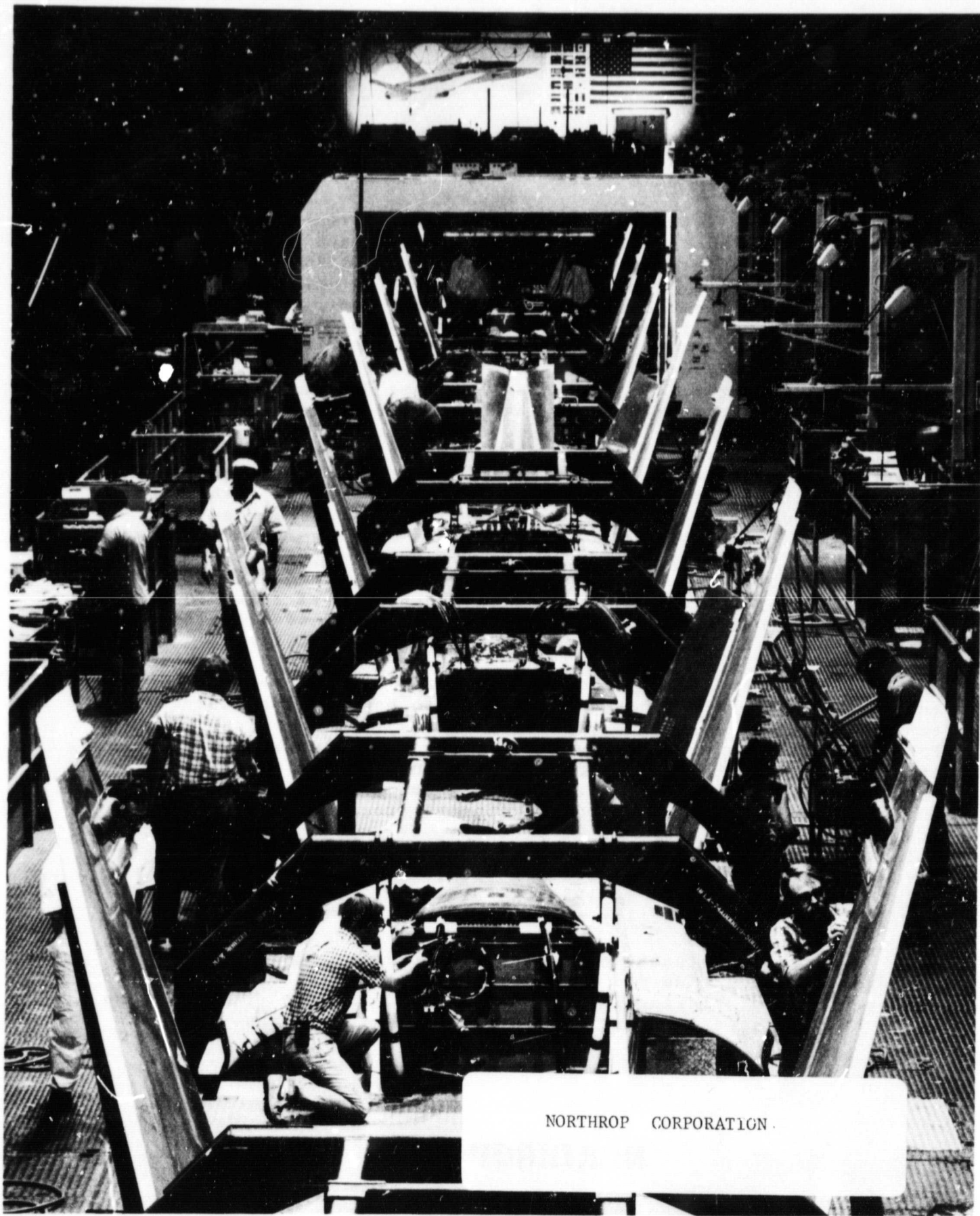
Productivity improvement, especially improvement in the quality of our products, is the cornerstone of our cost competitiveness strategy. Quality and productivity go hand-in-hand; quality improvement automatically increases productivity. If we reduce all the costs of poor quality (rework, scrap, waste), we will achieve more output with the same input.

The importance of involvement of our people at all levels cannot be overstated. The climate we create for participation will determine our success. Northrop has developed ten points in its commitment in managing people: (1) the necessity to establish and build managerial trust and credibility, (2) the need to effectively facilitate the flow of ideas between employees and management, (3) increased involvement of the work force in problem solving and decision making, (4) provision of proper incentives and recognition for motivation, (5) proper development of our management, (6) proper training of the work force, (7) improved screening of our employees at the time of recruitment, (8) creation of a performance oriented environment, (9) fair pay and promotion actions based on performance, and (10) execution -- movement of ideas for improvement into actual practice.

The Aircraft Division demonstrates the success we have had in increasing our productivity. The Division has received three consecutive Productivity Recognition Awards from the U. S. Air Force Contract Management Division. This year's award was in the category of material and subcontracts; the Aircraft Division instituted a plan to reduce the cost of subcontractor-supplied parts on the F/A-18. As a result of this program, Northrop achieved cost reductions of 22 percent over two years, a savings calculated to amount to \$125 million. In 1985, Northrop Aircraft Division won the Air Force award for reducing direct labor costs on the F/A-18 and again in 1984 for achieving substantial gains in the quality and reliability category on the same program.

There are no panaceas to the productivity challenge. Real improvement takes time and there is risk in trying to change. We at Northrop are sticking to the fundamentals and are providing top level commitment and leadership for the long-term focus.

NORTHROP



NORTHROP CORPORATION.

PAN AMERICAN SERVICES, INC.

Employee involvement in company objectives and improvements in the quality of work life (with concomitant increases in motivation and productivity) were the early Pan Am concern that provided the incentive to develop a complete Productivity Improvement and Quality Enhancement (PIQE) Program. Through the Employee Action Circles, the company significantly improved its vertical and lateral communication. Managers did not initially recognize the necessity nor did they have the desire to support employee involvement programs, but the Employee Circle concept (using employee knowledge to improve performance and quality of worklife) gained a momentum. Management realized the value of working with the employees for change and provided prompt attention to needs and requests for equipment, or aids, to ease work efforts. This genuine response by management is recognized by our employees as a sincere concern for worklife improvement. Persistently selling programs to employees, and recognizing the need to refine programs through the feed-back of participants has proven effective for Pan Am as we move forward with our PIQE program.

Incentives must be perceived by the worker as a benefit and not as a method for management to "come out ahead". Pan Am has attempted to bring about changes that result in increased productivity and quality of work through management intervention at the worker level, by selling the change with incentives identified up front. Our approach has been:

- Opening communication through Employee Circles.
- Expanding incentives and recognition in the Cost Reduction Program.
- Development of a worker progression programs.
- Organizational restructuring.
- Reduction in Supervisory levels.

Currently we are approaching individual shops to develop productivity measures and to provide a climate for participative goal setting by management and workers. This project aims to gain support up front through shop participation, to identify the need for clear, sensible performance measurements, understood and accepted by the workers as valid indices of their productivity.

Our approach, although not necessarily original, incorporates proven techniques and programs that we have tailored to our organizational structure - recognizing that there is some reluctance to anything new, and that employees will not agree to change without understanding. We want our employees to feel that they are caring, feeling, mature individuals with the inexhaustible ability for high performance.

IMPLEMENTING CHANGE—SELLING THE PROGRAM

**INCENTIVES FOR
QUALITY AND PRODUCTIVITY GAINS
WITH
PAN AM WORLD SERVICES, INC.
AT THE
NATIONAL SPACE TECHNOLOGY LABORATORIES
(NSTL)
MISSISSIPPI**



ENCLOSURE II

Parker Hannifin Parker Bertea Aerospace Group Gas Turbine Fuel Systems Division produces complex, extremely close tolerance fuel nozzles for both military and commercial gas turbine engines.

Many high precision, high quality detail parts are required of each nozzle assembly, and high volume is required to meet customer demands.

One of its manufacturing divisions located in Andover, Ohio, is required to produce over 9,000 precision machined parts monthly to meet production schedules, with extreme emphasis on high quality with tight cost control.

The division used several "captive vendor sources" to augment its own capability to maintain required throughput. However, vendor lateness and quality problems required that this work be brought back under Parker control to meet the quality and rate production required.

The division first designed a Flexible Manufacturing System (FMS) which would be capable of producing the most difficult part families. Over three thousand six hundred (3,600) parts are now produced monthly in this cell. The outstanding results in terms of productivity, quality, and job change over flexibility led to another cell where dedicated parts could be produced.

This is not a FMS where several models in a part family could be processed. This "cell" or work center was designed for two (2) models of the CFM56 Engine Fuel Nozzle housing exclusively. Prior to the establishment of this cell, components were produced in batch lots in the conventional and traditional department-to-department work flow arrangement.

In spite of good operation by operation cycle times, job lot queuing, reset and separate machine tool scheduling throughput was a maximum of 470 units monthly. Two new machines tools were purchased, one older machine tool was retrofitted and the department was rearranged based on routing progression and measured cycle times. In essence, subsequent operations were designed to match the throughput of pacing operations, i.e., no tool was designed to produce more than the prior operations could provide, hence, the majority of emphasis was placed on the pacing operations to meet desired throughput levels.

Upon completion, seven (7) machine tools with CNC controls completed this work cell.

Currently, nine (9) employees operate this cell over three shifts, three per shift, and produce an average of 1684 housing monthly.

During the conventional method of manufacture, nine, and sometimes more employees were utilized to produce the average of 470 units and first operations were subcontracted.

Technology Advancement

A number of advanced design and manufacturing technologies have been adopted by Optical Group to improve productivity in terms of reduced cost, schedules and improved product quality. A few of these include the adoption of CAD/CAM systems in design, documentation, manufacturing, and facility planning. Computer controlled manufacture of optics, and computerization of Manufacturing and Quality tracking and disposition systems. A computerized drawing ordering system is now in development for the rapid processing of drawing requests.

Facility Modernization

Productivity improvement considerations have played a key roll in the selection of equipment and the facility layout of our new Special Optical Facility that will be completed shortly. Equipment will include a Campbell Grinder that replaces three machines previously used to produce optical components (coring, hexing, and surface generating machines); a numerically controlled aspheric milling machine; a computer controlled polishing machine for fine grinding, polishing and figuring; a Draper polisher; a vertical vacuum, test chamber; and an 80-foot metrology test tower. The layout is designed to provide support to state-of-the-art optical systems in a environment designed to facilitate the work-flow.

Quality Management

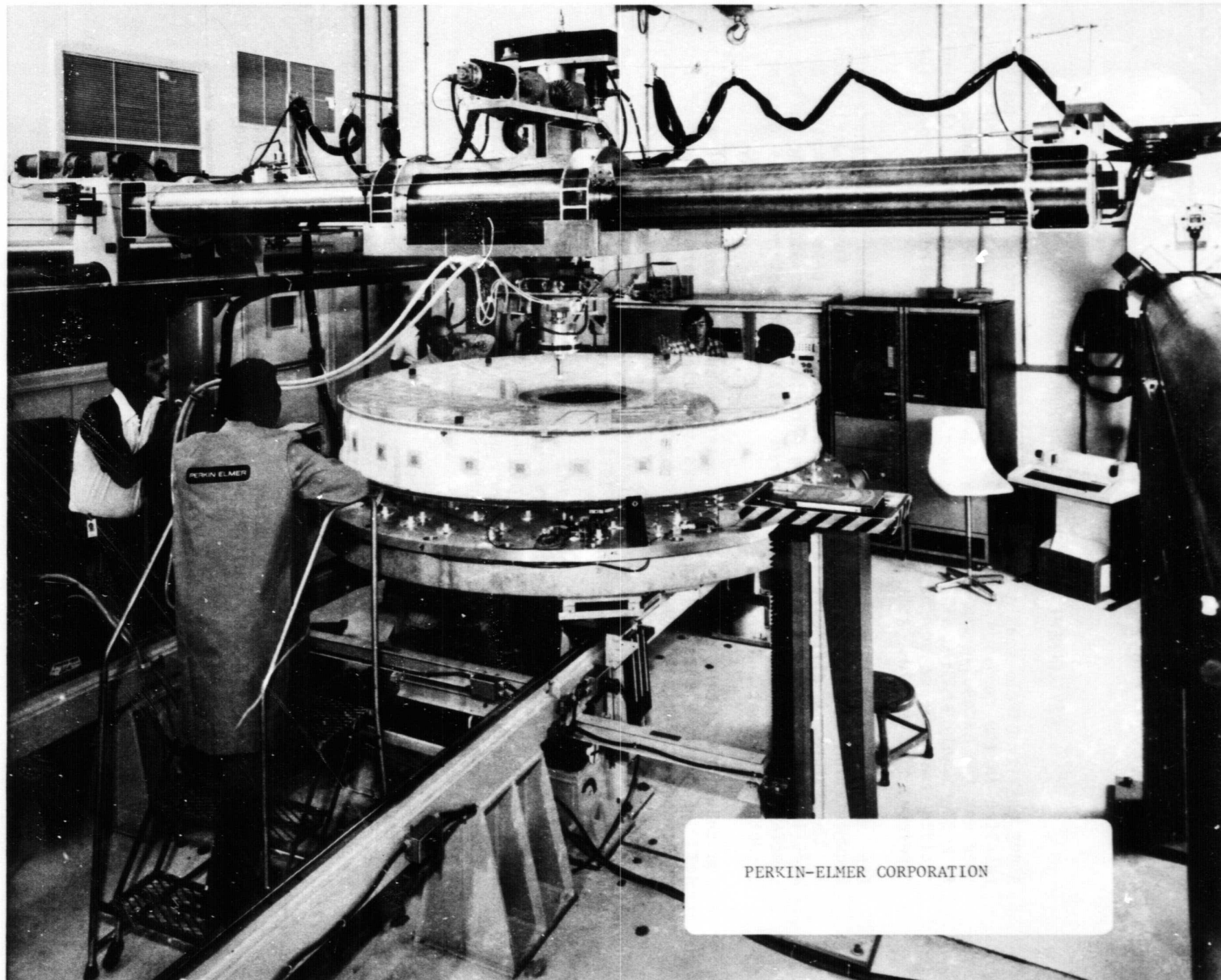
Subcontractor Performance is a key element in our overall performance/productivity, and is therefore closely monitored and controlled. Problems must be quickly pinpointed, addressed, and resolved. A computerized system has been developed to monitor and assess subcontractors quality, cost, and delivery performance to provide this vital information; it also identifies good/poor suppliers and assists in vendor selection.

The cost of quality in complex hardware programs is often significant. The productivity of Quality systems and functions is therefore a continuing concern. A measurement system has been developed to identify, measure, and focus on redesign, rework, failure and scrap costs. This data is accounted to by contract, by hardware line item, and to the cost center or responsible individual. This computerized system provides rapid access to data, facilitating its overall analysis, and assessment of productivity improvement measures.

Employee Productivity Incentives

During the manufacturing phases of the Optical Telescope Assembly for the Hubble Observatory, incentive plans were adopted; STAR of the week, and Team of the Month. These were so effective that a formal recognition program called PRIDE, for Productivity, Resourcefulness, Initiative, Determination, Excellence was initiated. This is awarded to any employee, that makes a significant contribution towards positive growth, morale, and progress of the Optical Group. This program was extended to team efforts as a PRIDE TEAM award. Individuals, or teams, that demonstrate significant accomplishments, performance, teamwork, ownership, resourcefulness, and effective communication are considered monthly relative to others. The recipients receive a PRIDE pin, a Certificate, and a significant financial award. A less formal system, administered on a local level, known as Peer Group Recognition for Productivity, has also been adopted by Manufacturing.

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PERKIN-ELMER CORPORATION

PLANNING RESEARCH CORPORATION
PRC Systems Services
Thomas R. Brown, Jr.
P. O. Box 21266
Kennedy Space Center, Florida 32815
(305) 867-7426

DEVELOPMENT OF SOFTWARE STANDARDS MANUAL

A PRC Quality Circle team's search for impediments to productivity and quality resulted in the decision that the most significant detriment in the software area was the excessive amount of time required for software maintenance. The team thoroughly studied all possible causes for this undesirable situation and decided that the major cause was the lack of a standardized approach for development of original software.

Too often original software is created and released with inadequate documentation and definition. When software needs some form of modification in the future, a difficult task is presented to the person attempting the modification. Without having supporting material for assistance, the software specialist is left with only a program listing to determine the original structure, content and intent.

The solution to this problem is the creation and implementation of a manual setting forth a standardized process to guide software development and maintenance. The solution includes the writing of a software design standard that covers system design, coding, testing, documentation, configuration control, training and new software technology. The software standard is in development with a goal of September 1986 for a fully-operational process.

This standardized process, featuring a modular structure, will not only greatly facilitate software maintenance but will also enhance productivity and quality in the creation of the original software. It will reduce the complexity of all software assignments, make software easily extensible, give software much greater stability to changes, and will provide better and easier testability. Use of the standardized process will result in a superior end product.

The underlying problem surfaced in PRC's work for the Kennedy Space Center; modifications to software developed by numerous contractors are required. The standardization process, a part of PRC's product improvement program, should improve both productivity and quality.

Improvements in productivity are expected to achieve payback within the first six months after introduction with continuing cost savings from that point on. Increased quality of the resulting software products will produce additional cost benefits.



Planning Research Corporation

PRATT & WHITNEY'S PRODUCTIVITY IMPROVEMENTS

United Technologies' Pratt & Whitney is actively engaged in several major programs designed to provide significant near- and long-term productivity improvements throughout the company.

One key activity is the Cost Reduction Program at P&W's Government Products Division (GPD). In the past ten years, GPD employees have contributed suggestions which have yielded cumulative cost reductions of \$517 million. This translates into sizable savings in military procurement costs, which benefit not only the company, but the United States government, and ultimately the taxpayer.

GPD's cost reduction program is recognized as one of the most successful in the nation, and the division has won the National Association of Suggestion Systems (NASS) national award for the greatest cost saving per employee for six consecutive years. The most recent NASS award recognized an average saving of \$11,681 per GPD employee. P&W is believed to be the only company which provides incentives for employee suggestions which benefit the customer, regardless of any direct benefit to the company.

P&W also has introduced a company-wide, long-term approach to improving the quality of its operations through the "Quality Plus" process. Q+ uses a total organizational approach to encourage employee participation in all aspects of the business. Its emphasis is on prevention of non-conformance, rather than detection and correction.

On the shop floor, the Manufacturing Division is re-arranging its existing machines into flowlines where everything needed to make an individual part or assembly is concentrated in one location. On the first flowline, non-conformances were reduced 80 percent from the 1984 level.

Additional cost reductions and productivity gains are being realized as a result of P&W initiatives:

- continued investment in modern facilities and equipment;
- participation in the U.S. Air Force's Technology Modernization program;
- coordination of purchasing activities both within P&W and throughout United Technologies;
- improved cooperation between the Engineering and Manufacturing divisions which design and build engines;
- continued work on the Product Design Center which assists in the more efficient development of new engines, materials, and processes;
- implementation of a new cost accounting system which seeks to control overhead costs.

These activities position Pratt & Whitney to maintain a leadership position in today's competitive market by striving to produce superior products at the lowest cost.





In the past year, Pyronetics has implemented two new programs which have improved productivity and quality.

We have instituted a Material Requirements Planning (MRP) Program which plans and controls production from receipt of purchase order through delivery of product. The system also coordinates drawing and document revisions to hardware on order or jobs in progress to ensure the latest changes are always implemented. This has eliminated the need of several different departments maintaining duplicate records for hardware delivery status, job in progress status, etc. All information immediately available and up-to-date is in the computer. This has correspondingly reduced the amount of time spent exchanging information in meetings.

We have also instituted monthly meetings for the Quality Assurance staff for briefings on new programs and their special requirements. Any problems or events requiring special attention are discussed.



Raytheon Service Company

Stanley L. Groover, Program Manager for the
Logistics Mission Support
Contract

Goddard Space Flight Center
Code 539
Greenbelt, MD 20771

Telephone No. (301) 344-9620 286-9620

Barcode Application in GSFC Supply Activity Realizes

Large Productivity Benefits

Productivity in the Logistics Support Depot at the Goddard Space Flight Center depends on our employees ability to quickly and accurately perform, control and report their given responsibilities.

The MIL-STD 3 of 9 Barcode data collection system sets our personnel free from cumbersome paperwork data tracking. The automated Barcoding System in use at GSFC is outlined below:

- o Supply Areas Utilizing Barcoding
 - o Receiving and Inspection
 - o Warehouse Issues
 - o Traffic Management (Shipping Documentation Preparation)

The benefits realized from the use of the Barcoding system are:

1. Elimination of Key punch Cards
2. Real-Time Updating of Records by Scanning
3. Number of items handled through receiving and inspection doubled within no increase in manpower.
4. Eliminated need for manual keypunching of data in Shipping Document Preparation.
5. More complete, useful information furnished to customer.
6. Reduced possibility of manual error.

This Barcode System enables the GSFC Logistics Support Depot to service an average of 13,000 customer orders a month in the most cost effective and productive manner.



RCA Astro-Electronics
P.O. Box 800, Princeton, NJ 08543
Attn: E. T. Wojciechowski (609) 426-2748

RCA Astro-Electronics has made significant capital investments in computers to improve the overall quality and productivity of its Engineering and scientific workforce. A summary of some of these resources and achievements to date is given below.

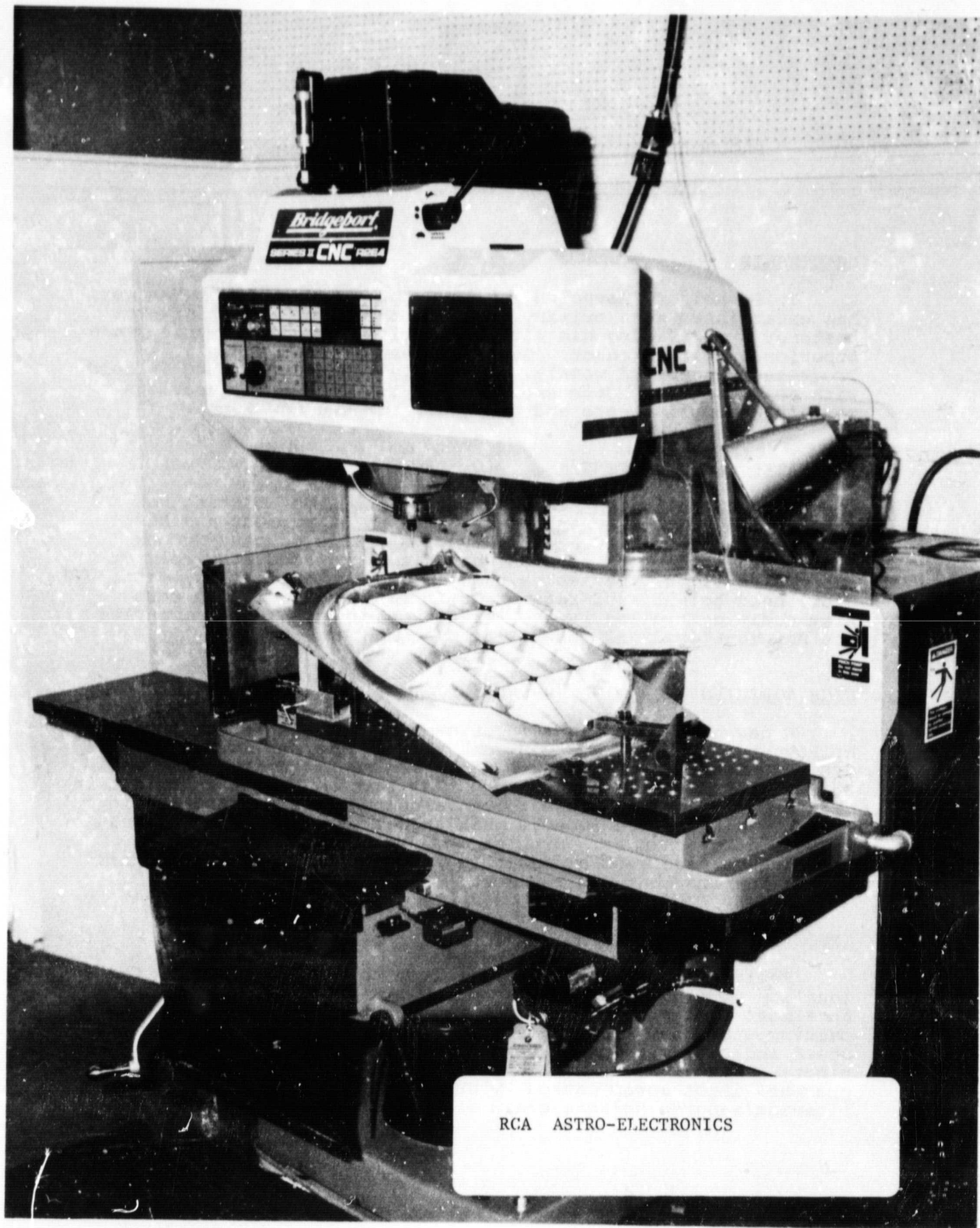
Computer Aided Design/Drafting/Manufacturing. Astro has a Prime/Medusa Computing System that permits development of solids modelling with full 2-D and 3-D drawings. The system produces a common data base for interfacing with various Engineering disciplines, such as thermal, radiation and structural analyses and allows for the creation and checking of complex spacecraft design layouts. The Prime system has long-line communications with a remote IBM computer where our central data bases are stored for use with an in-plant VAX 11/780 computer complex where computerized thermal and mechanical analyses are performed.

Astro has expanded CAD to CAM operation by having the Prime/Medusa System provide direct programming inputs to in-plant CNC equipment located in a remote machine shop, as well as out-of-plant CNC equipments at subcontractor facilities.

An example of this CAD/CAM capability is illustrated in accompanying Figures which show a Parabolic Antenna Reflector for the Advanced Communications Technology Satellite System (ACTS) which was produced electronically; i.e., no paper drawings. Specifically, we see a completed 3D view of the Reflector on the Designer's console. All necessary geometry data describing this Antenna Reflector are transferred to a central data base, and subsequently accessed via data lines by the CNC equipment in a remote in-plant machine shop. The finished machined product is shown in the accompanying photograph. The Reflector was produced with no quality defects.

The Prime System has also been used extensively in producing conceptual design of polar and co-orbiting platforms for NASA's Space Station Work Package No. 3. Design information contained in the data bank is regularly accessed for use in reports and presentations to the NASA Space Station Office. In addition, Astro provided JSC with a magnetic tape (in lieu of drawings) of different conceptual designs for review and evaluation by NASA engineers using their local computing resources.

The Prime/Medusa System has been recently upgraded and expanded for greater capacity and throughput. Astro's productivity gain using the Prime system is currently estimated to be 2.5:1; i.e., one trained Prime Operator can produce 2-1/2 times the quantity of finished drawings that one draftsman can produce in the same amount of time using conventional (manual) drafting techniques.



RCA ASTRO-ELECTRONICS



PRODUCTIVITY IMPROVEMENT AND QUALITY ENHANCEMENT

REYNOLDS METALS COMPANY - MCCOOK PLANT

LEADERSHIP

J. B. Kelzer, Reynolds Metals Company-McCook Plant Manager, has established as a primary goal for the plant to satisfy the customer by providing him with a superior level of service and a superior quality product. Goals are established monthly. Progress is reported weekly. A monthly luncheon meeting is held with 40 department heads and managers to discuss the previous month's accomplishments and the goals for the new month.

AUTOMATED INGOT CASTING

Automatically controlled direct chill ingot casting has resulted in reduced scrap losses of up to 50 percent and has improved ingot quality at the Reynolds Metals Company-McCook Plant. Three casting stations have been upgraded at a cost of about \$1 million. Variables such as cooling water flow, metal flow, head height, and rate of grain refining additions were previously controlled by the furnace operator. These variables are now monitored and controlled by computers.

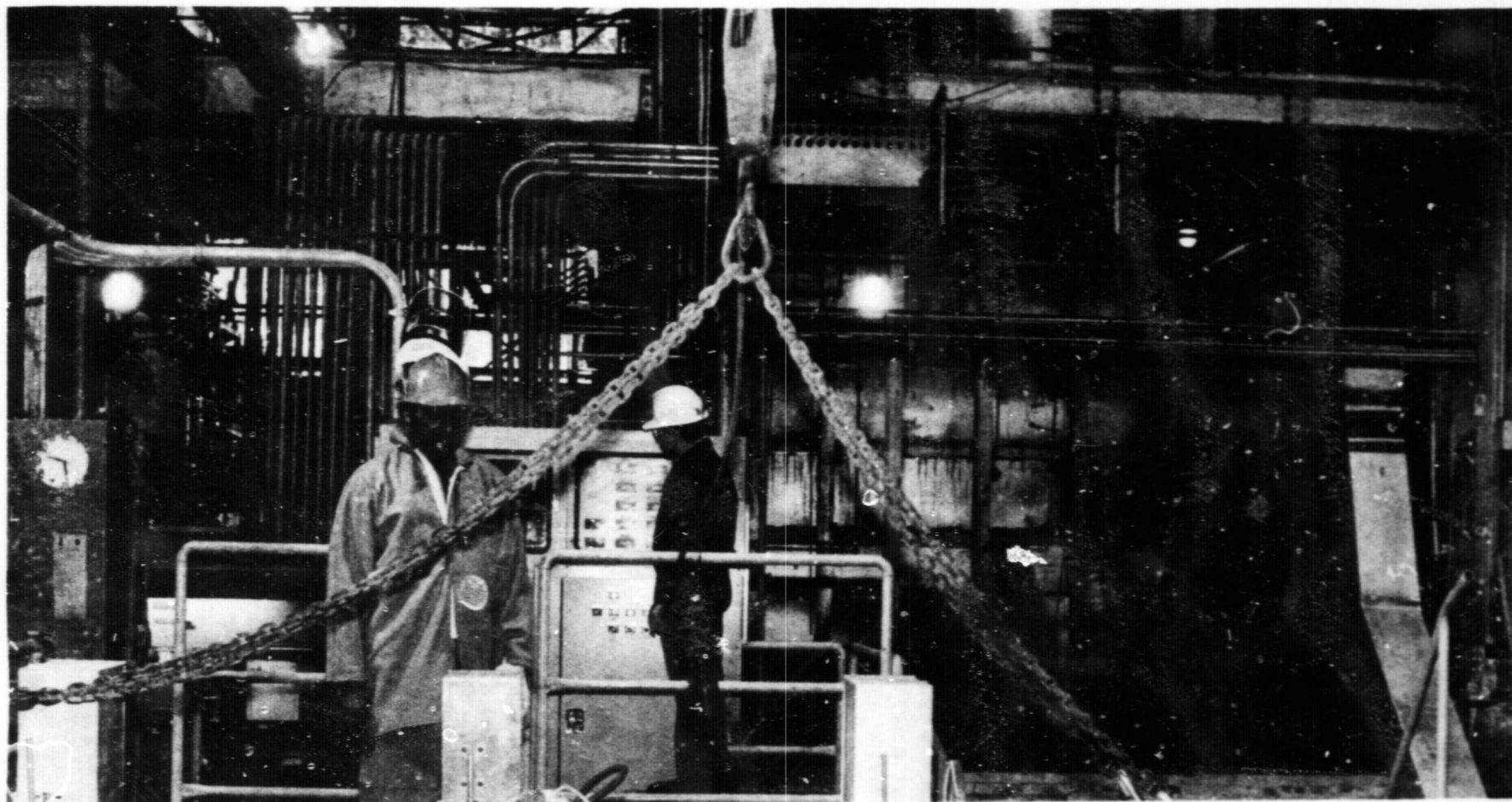
HIGH EFFICIENCY CASTING FURNACE

A new high efficiency ingot casting furnace is now operating at Reynolds Metals Company-McCook Plant. The new furnace has a 100,000 pound capacity hearth for charging and melting and an 85,000 pound hearth for casting. The casting hearth is unique in that it tilts to allow the molten aluminum to flow into the ingot molds. This feature reduces wash and drain scrap by 50 percent between alloy changes. High efficiency burners and furnace design have resulted in a melt rate two and one-half times that of the furnace that was replaced.

INGOT QUALITY

Follow-up of recommendations from the Reynolds-McCook CHAMPS (quality circle) team by the company's R&D staff has resulted in an almost fool proof system for feeding titanium rod at ingot casting stations. The rod speed control unit features true rod speed indicators and feed control accurate to ± 0.1 inch per minute. Visual and audible alarms signal malfunctions. The unit prevents ingot scrap caused by undetected rod stoppage. The titanium assures uniform grain size in the finished ingot.



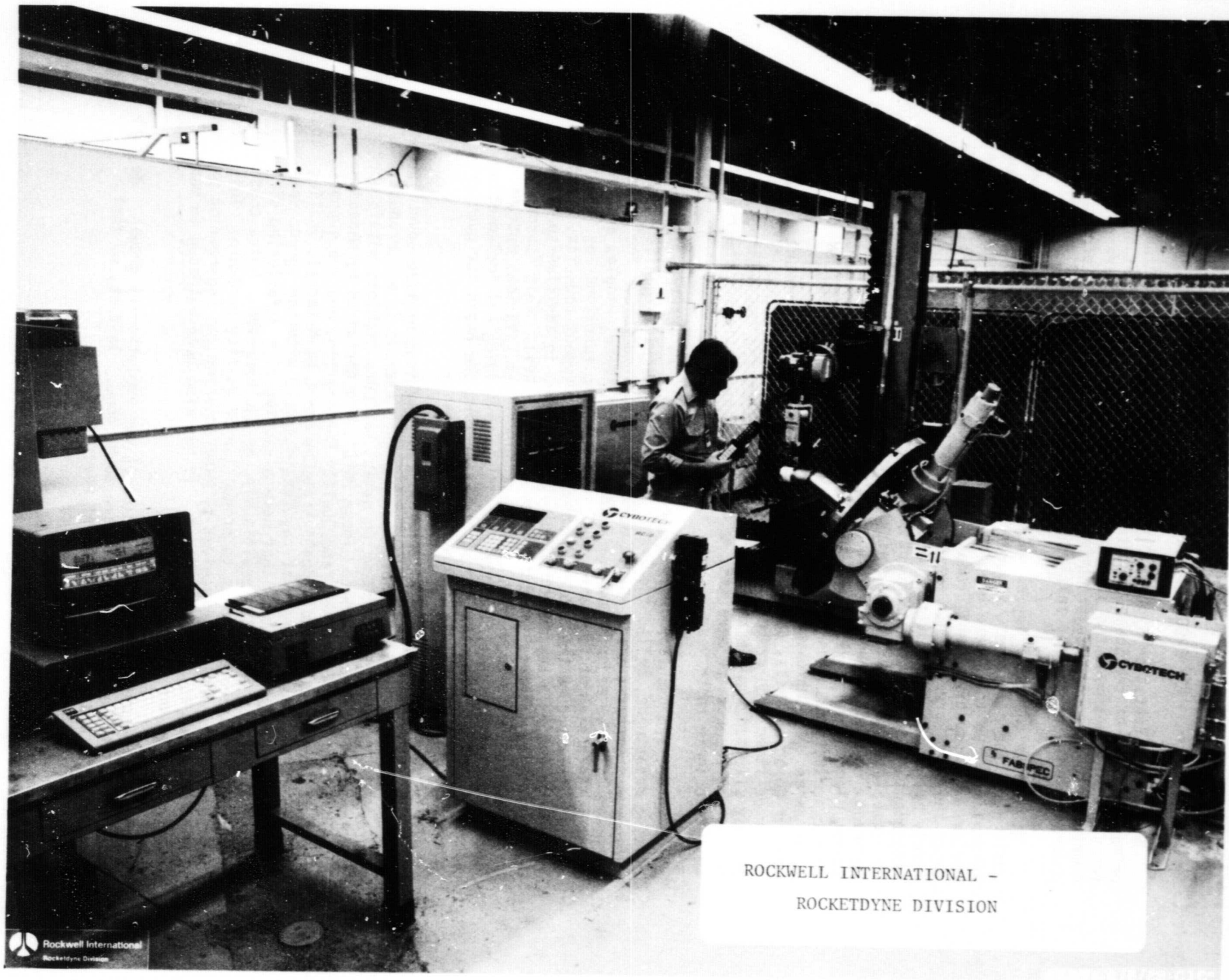


At McCook sheet and plate plant, Cast House Supervisor Richard Kendrick is at the controls as another in a series of three casting stations passes into the computer age. Noel Palmer, operator, watches as the molten metal fills the molds from the furnaces.



**ROCKETDYNE QUALITY/PRODUCTIVITY
INITIATIVES AS OF APRIL 1986
(CONTACT FRANK LARY: 818/710-6463)**

1. **Quality Enhancement Plan.** Program was designed to optimize the quality of Rocketdyne and supplier products and services consistent with contract requirements and program needs. It includes holding each member of management accountable for meeting contractual and internal requirements and audits to assure compliance. The success was demonstrated by the outstanding score on the joint USAF/NASA Contractor Operations Review in February 1986.
2. **Supplier Quality.** This program encourages suppliers to be more productive and quality oriented. Some of the activities of the program are: Supplier Symposiums, Quality Workshops, Supplier Newsletters Library of Motivational Films, Quality Circle Training, Supplier Snoopy Awards, Supplier Launch Honorees, and Supplier Seminars. As an example, a Forging Producers Seminar has resulted in a substantial improvement to these critical materials, no manufacturing shortages, and as 75% decrease in Material Review actions.
3. **Employee Training and Motivation.** Training programs have been developed to train employees to be more productive and quality conscious, including computer and management training and Quality Circle development. Interaction Management and Resources Management are designed to instruct managers in interpersonal skills and productivity improvement techniques. Programs have been established to motivate individuals and groups through incentives, recognitions and awards. "White Collar Productivity Improvement" teams have been organized to build effective work groups.
4. **Factory Modernization; Robotics.** A three-part program has been underway for approximately two years. The MSFC robotic cell has used a vision-based seam-tracking system to make simulated production welds. Three Manufacturing welding robots have been installed and checked out at the Canoga Plant. (See photo). Parameters have been developed for a total of 25 welds. The development robotic system with "preview" tracking is on order. Penetration sensing is under development.
5. **Horizontal Integration Among Functions.** This methodology, which has been used effectively on certain difficult hardware tasks, is being extended into three activities where interfunctional coordination is key. First, procedures affecting several functions are being integrated. Second, individuals are identified to carry out improvements involving multi-functions resulting from COR. Third, individuals have been assigned to interfunctional activities which have been found to be impediments to timely and efficient production of hardware.



ROCKWELL INTERNATIONAL -
ROCKETDYNE DIVISION

KEY PRODUCTIVITY AND QUALITY INITIATIVES



Space Transportation Systems Division of Rockwell International is the primary builder of the Space Shuttle orbiter. It is vital that our products for space missions meet the highest quality standards and we are actively committed to an aggressive product quality and productivity improvement process. A few of the key initiatives we have taken are highlighted herein.

We believe the major ingredients in improving productivity and product quality are the commitment, vigorous leadership and involvement of top management. Our policies have been developed to include top management quarterly reviews of Productivity and Product Quality Improvement (P&PQI). We have infused the P&PQI process into every organization throughout the division. We firmly believe that the success of the process is the responsibility of line management. For this reason quarterly reviews are held with our president and his immediate staff, which precipitate similar regular activity in each department. A broad agenda permits us to assess the many excellent improvements taking place in our division without overcontrol. Each management council member presents examples of accomplishments and plans in each of the following three areas: (1) improvements in product/services quality, (2) more effective ways of doing business, and (3) improvements in work environment/climate. The number of items each member presents is limited to those that fit within the one day allotted for the review. The president chairs the meetings, and only his direct reports are permitted to make the presentations. The reviews are well into their third year.

A unique approach for implementing P&PQI has been initiated in our engineering department, called the Triad of Excellence. It organizes desired improvement emphasis areas into a work breakdown structure. The Triad is composed of three major segments--Technical Excellence, People, and Productivity. Each segment is broken down into specific functions, or "trees," which in turn become the subject matter for improvement councils. Each council is led by a key member of management, who, in addition to his or her regular duties, directs the activities of the council. This "phantom organization" meets regularly to achieve objectives. Various options are developed, and the council is tasked with recommending and implementing approved actions. Results of this activity form the basis for quarterly presentations to our division president.

Many improvements cross functional lines and thus utilize Councils made up of expertise from various functions. One good example is our Product Quality Improvement Councils (PQIC's) which attack hardware problems within each production operations department. These PQIC's are cochaired by managers from each Manufacturing department and Quality Engineering, and are supported by the most knowledgeable individuals from Engineering, Material, Tooling, and Planning. The Councils meet at regular intervals with the agenda determined by upcoming production items that have histories of manufacturing difficulties. The PQIC's can act expeditiously, as the approved minutes constitute authority to remove obstacles to production of quality hardware. This concept has been enthusiastically received by Manufacturing and Engineering personnel and by NASA and Rockwell management. It has also been extended to many of our subcontractors and suppliers.

These accomplishments are examples of our evolutionary growth. We have made great strides, but there is more to be done. In fact, we feel productivity and quality improvement never ends.

Computer-Aided Design

Payload/Cargo Integration generated Cargo Arrangement Drawing VA72 on the Computerized CAD system CADDOS-3 software to support the successful Space Shuttle 51A mission November 1984. The drawing graphically established the cargo locations and anchored the payload carriers in the orbiter bay. The basic geometry of the cargo bay was transposed from an established layout on an earlier CAD drawing. The mission achieved all objectives, including deployment of the Syncom 4 telecommunications satellite and recovery of the errant Pegasus and Western spacecraft.

The CAD system allows engineers to generate full size drawings to exact dimensions. When the drawing is com-

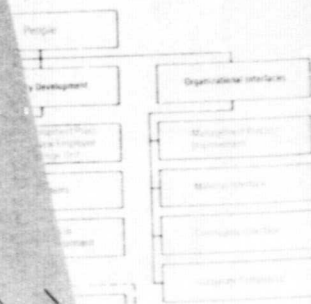
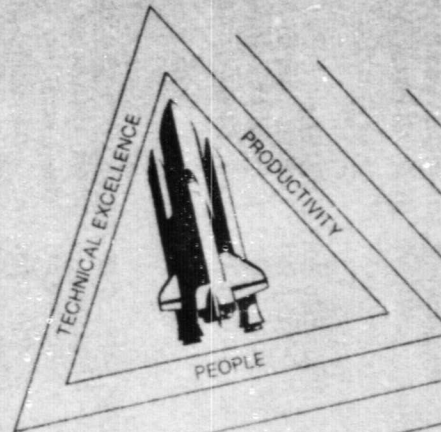


PEOPLE

Hank Dittmer



ENGINEERING TRIAD OF EXCELLENCE



ROCKWELL INTERNATIONAL -
SPACE TRANSPORTATION SYSTEMS

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SCHAEFFER MAGNETICS PRODUCTIVITY AND QUALITY OVERVIEW

"Perhaps the word 'productivity' has become overworked. We hear it everywhere we turn and it seems to have lost its meaning. Lately, at Schaeffer Magnetics we are thinking more in terms of 'effectiveness' or 'effectivity'".

This year we initiated a program to promote a sense of pride and team participation. We have regular company wide "donut talks", where we discuss motivational topics. We started a company newspaper and we periodically issue motivational buttons.

We are investing in inventory. We stock 'S' level electronic components and long lead items such as bearings. We make larger runs on CNC produced parts (additional parts to inventory). This reduces turn-around time on new orders and helps to assure on-time deliveries.

We have a vigorous capital re-investment policy. This year we acquired a new thermal vacuum chamber that will reduce acceptance test costs on a current contract by \$70,000. This year we also established a flow solder capability that will significantly reduce the cost of electronic assembly. We also installed a liquid nitrogen storage system that reduced LN2 costs by 70%. And we acquired a CAD system for electronic circuit drafting.

Backward integration. We have always maintained a strong policy regarding in-house capability. Consequently, we maintain an unusually high degree of operational independence and control over many aspects of our business.

All of the foregoing, contributes to improved cost, quality, schedule performance ... and to the overall effectiveness of our company.

SCHLOSSER FORGE COMPANY
11711 Arrow Route
Cucamonga, CA 91730

Focal

Individual: J. P. Schlosser

Phone: (714) 987-4760

PRODUCTIVITY ENHANCEMENT - FLEXIBLE FORGING CENTER

The close proximity of heavy equipment and hot forgings to shop personnel has been of great concern to management. Also, we have been looking for ways to reduce the number of people in a forge crew. Both goals have been achieved with the installation of "Man-Mate" manipulators. Two operators work from the air-conditioned cabs of these manipulators and control the operational variables of a forge press, a ring mill, and furnace doors. In addition, furnaces can be loaded or unloaded, rolling mandrels selected and changed, and finished parts loaded onto a sizing machine. Productivity has been enhanced by: improving the operators' working environment; improving operators' safety by reducing fatigue and eliminating danger of being struck by moving parts; reducing crew size from five to two.

PRODUCTIVITY ENHANCEMENT - ENERGY CONSERVATION

We have been actively trying to reduce the consumption of natural gas, and have been successful in two areas. First, we have replaced steam operated equipment with modern, efficient hydraulic/electrical equipment. Second, we are replacing old furnaces with new furnaces equipped with low-mass refractories, self-recuperating burners, positive seal doors, and precise electronic combustion controls. As a result of these efforts, we reduced fuel costs by approximately 23% in 1985. Our final goal is to completely eliminate our boilers, which will further reduce fuel consumption.

02



SCHLOSSER FORCE COMPANY

SIMCO Electronics
382 Martin Avenue
Santa Clara, CA 95050
(408) 727-3611
Attn: Mr. Carl Quinn, President

Productivity in technical service is a critical issue at SIMCO because instrument calibration and repair is the company's core business. The ability to compete for contracts is determined by our ability to deliver the highest quality technical service with limited manpower.

Two areas of recent productivity improvements benefitting NASA were the development of an On-Site Calibration And Reference System (OSCARS) and initiation of the Voltage Measurement Assurance Program (MAP).

On-site calibration has been developed as a system, encompassing mobile equipment, appropriately-trained manpower, procedures, and quality assurance. Using a mobile cart shown in the photo, OSCARS is regularly scheduled to field locations where equipment disassembly and transportation to a central calibration facility is difficult. Equipment can be custom-tailored for the specific location requirement.

Highly trained manpower using procedures adapted for on-site work assure broad capability. Quality assurance procedures specifying that each OSCARS technician check the other's work, with 100% paperwork check by central QA assure accuracy of the on-site calibration.

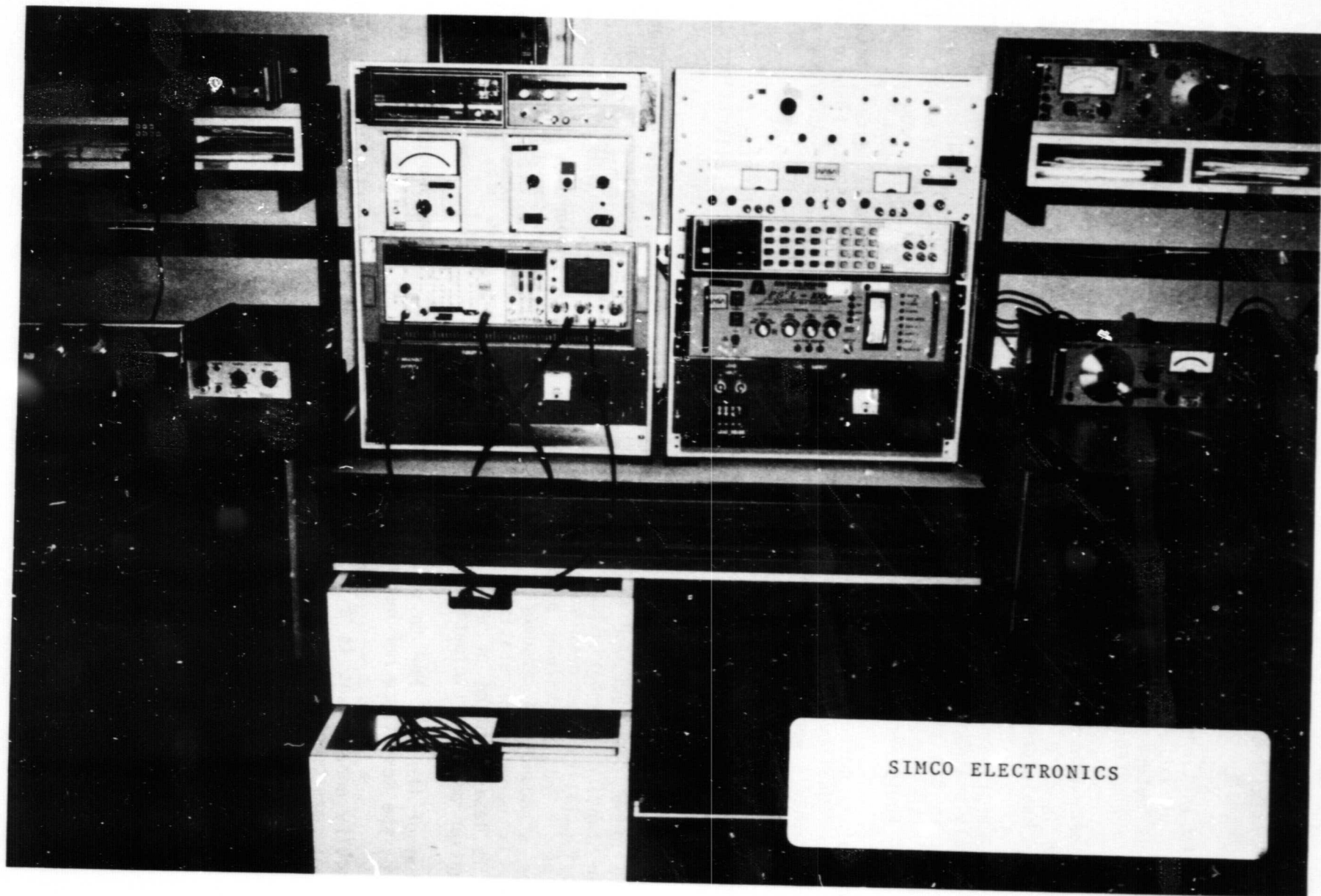
Due to savings in test equipment downtime and lessened disassembly time for calibration, OSCARS is used today on 20% of the Ames Research Center calibrations by SIMCO.

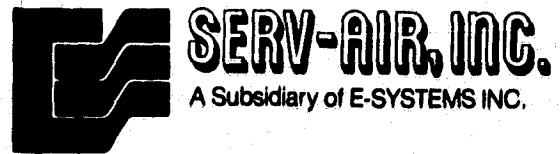
Separately, development of the Volt-MAP for NASA has begun this year with coordination of Ames-Moffett and Dryden Research Center voltage standards. Using a transfer standard and statistical quality control techniques, the volt standards of the two facilities have been intercompared for reference to the National Bureau of Standards. This technique allows accurate statistical comparison between the transfer standard and standards in each laboratory. Resolution of correction factors is based upon statistical uncertainty of the measurements taken. The result is less downtime of working standards for submission to NBS, and enhanced coordination among participating labs.

Extension of the Volt MAP to other NASA facilities will follow precedents established by the Resistance MAP begun at Langley, and that for Mass managed by Kennedy.

Productivity enhancement is a critical effort at SIMCO, and continually receives important commitment of manpower and development funding.

8





SERV-AIR INC - ADRF
P.O. Box 273
Edwards, CA 93523

PRODUCTIVITY AND QUALITY INITIATIVE OVERVIEW:

SERV-AIR INC, THE MAINTENANCE OPERATIONS CONTRACTOR FOR AMES DRYDEN FLIGHT RESEARCH FACILITY, HAS IMPLEMENTED SEVERAL INITIATIVES NOT ONLY TO ENHANCE QUALITY OF WORK AND PRODUCTIVITY BUT TO IMPROVE THE WORKING ENVIRONMENT AS WELL.

AMONG THOSE INITIATIVES IMPLEMENTED TWO HAVE HAD A MARKED EFFECT ON THE ADMINISTRATION AND OPERATIONS OF THIS CONTRACT. FIRST, EARLY IN JULY 85 SERV-AIR RE-ORGANIZED THE MANAGEMENT STAFF; SECOND, WITH NASA-ADRF ASSISTANCE, STARTED A COMPUTER PROGRAM SYSTEM TO BRING CONTRACT DATA AND INFORMATION INTO A CENTRALIZED LOCATION.

THE RE-ORGANIZATION OF THE STAFF SEPARATED THE ACCOUNTING AND PURCHASING FUNCTIONS, HERETOFORE PERFORMED UNDER THE SAME "HAT." THIS ACTION HAS EXPEDITED ALL REQUISITIONING ACTIONS AS WELL AS THE PROCESSING OF PAYMENTS THEREOF. A BONUS EFFECT HAS BEEN A CLOSER AND TIGHTER CONTROL OF ALL INVENTORY OF MATERIALS, SUPPLIES AND EQUIPMENT; THEREBY SAVING VALUABLE TIME AND IN THE LONG RUN, MONEY.

THE INTRODUCTION OF A COMPUTERIZED SYSTEM HAS PROVIDED A CAPABILITY TO ACCOUNT FOR ALL PERSONNEL ACTIONS, i.e. VACATIONS, SICK LEAVE, L.W.O.P., etc, ACCURATELY AND EXPEDITIOUSLY. PAYROLL COMPUTATIONS AND PREPARATION OF CONTRACT REPORTS SUCH AS 533M's AND 5330's ARE NOW BEING PROGRAMMED FOR A BETTER RESPONSE TO CUSTOMER REQUIREMENTS.

THESE AND OTHER ACTIONS HAVE IMPROVED WORKER'S SATISFACTION HENCE INCREASED PRODUCTIVITY AND THE QUALITY OF SERVICES PROVIDED--AT TIMES ABOVE AND BEYOND THE SCOPE OF THE CONTRACT.

Contact: Frank J. Cirillo, Senior Vice President 802-877-2911 x-2202
SIMMONDS PRECISION -- ISD
Panton Road, Vergennes, Vermont 05491

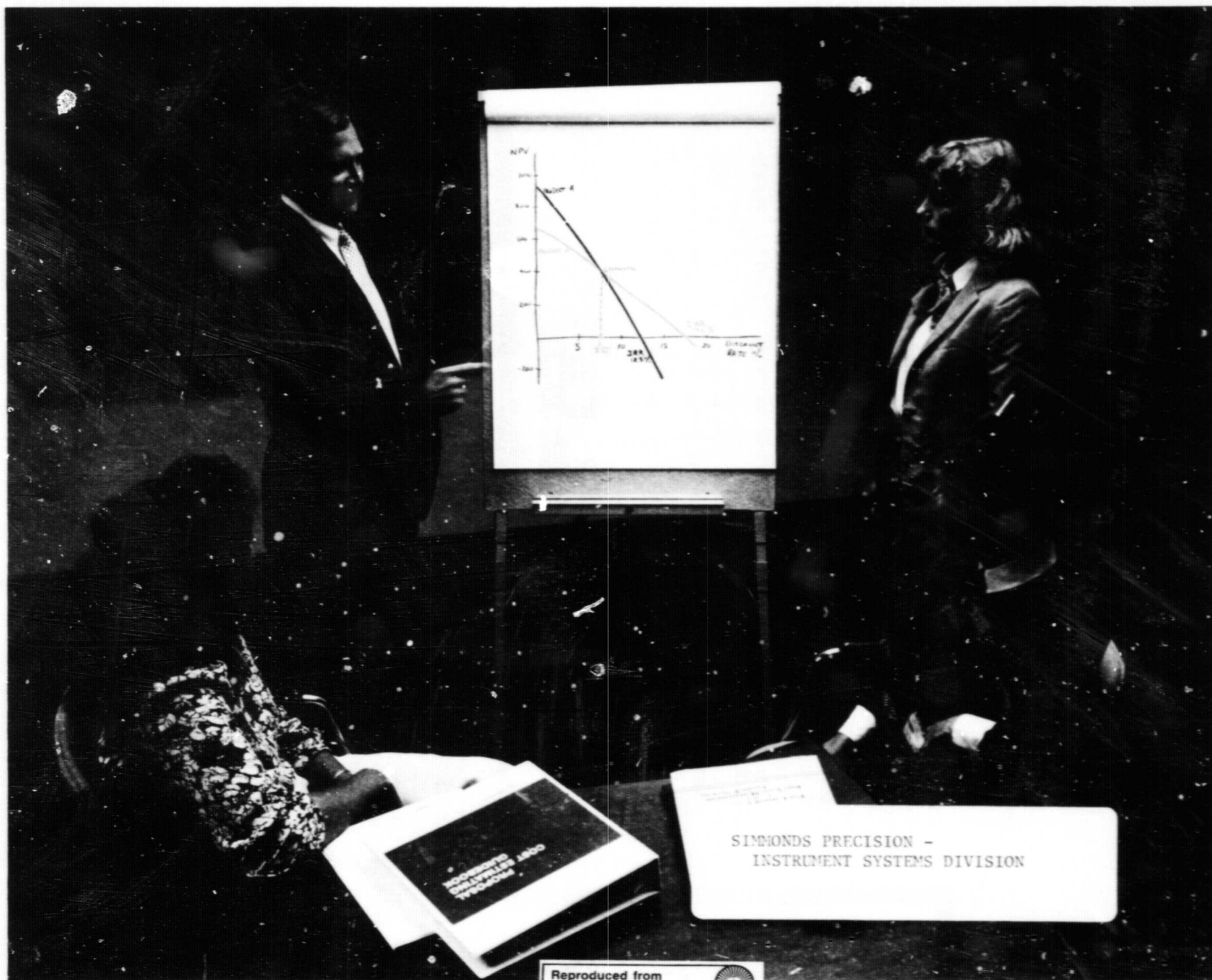
SIMMONDS PRECISION - INSTRUMENT SYSTEMS DIVISION

QUALITY AND PRODUCTIVITY ACHIEVEMENTS

Corporate Strategy Statement: Recognize that Quality and Productivity are inseparable concepts. We will develop a company-wide commitment to achieve continual improvement in response to our competitive environment. Quality excellence must be reflected in the physical product, the governing policies, procedures and documentation.

In 1984, the Division was awarded the first U.S. Senate Productivity Award in recognition of its achievement in the area of productivity and quality improvement. Some of these achievements have included:

- o Active participation in the United States Air Force Industrial Technology Modernization program. Improvements implemented to date have included:
 - o Laser Metal Cutting
 - o Robotic Work Cell
 - o In-Circuit Board Test
 - o Optical Scanning Indicator Test
 - o High Speed Machining
 - o Two-Lathe Work Cell
- o Established Interdivisional Task Team to improve quality and productivity by working with other divisions of Simmonds. Achievements to date include the development of uniform productivity and quality barometers which have been incorporated into monthly reporting package for all divisions. The team has also sponsored interdivisional meetings to deal with topics of interest such as Cost of Quality systems.
- o Implemented the Juran Quality Improvement Program at all divisions. A Quality Council has been established, consisting of Division top management and chaired by the President. Teams have been established to deal with specific quality and productivity problems.
- o A Quality Management System was established in 1985 which has been recognized by customers and government representatives for its excellence.
- o Quality Circles continue to contribute to productivity improvement. Currently 22 circles are actively functioning. 1985 cost savings of \$229,000 were realized. Cost savings ratio for 1985 was 4.35 to 1.
- o Zero Defects programs are underway in several work centers.
- o A Dinner for Two program has been established to award outstanding achievements at all personnel levels for innovative contributions to quality and productivity improvements.
- o Formal Product Support Task Teams consisting of Quality, Design, Industrial and Manufacturing Engineering personnel have been established to actively pursue ways to improve quality and productivity.
- o A scrap awareness program has been launched to improve productivity and quality by focusing attention at all personnel levels on the opportunities for savings in this area.



GEORGE R. TILLEY
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PRODUCTIVITY IMPROVEMENT

The Link Flight Simulation Division of The Singer Company, Houston, Texas, Space Programs Operations (SPO) has actively supported NASA's productivity improvement and quality enhancement program. SPO's General Manager, Dr. Riley D. McCafferty has fostered employee participation in furthering the goals of this important program. Link has implemented a series of initiatives while providing support services for the Johnson Space Center's Shuttle Mission Simulation (SMS) Complex. These have contributed to improvements in work force productivity, equipment availability and service quality. Link's Mission and Support Engineering organization (Manager, George R. Tilley), in conjunction with NASA, introduced a number of improvements in 1985. Five of these are documented within the boxes below. These items (excerpted from The Link Log: a newsletter for Houston personnel) exemplify Link's commitment to NASA's productivity improvement and quality enhancement program.

The Link Log

SMS AVAILABILITY INCREASED;
MAINTENANCE COSTS REDUCED
"...an integrated maintenance system has been implemented saving JSC approximately \$3 million to date in labor cost."

LINK AND JSC GENERATING SHUTTLE
VISUAL SCENES MORE EFFICIENTLY
"...system is expected to reduce development time of visual scenes by one half and computer checkout time by 40 percent."

SMS AVAILABILITY INCREASED
"...operations department has increased availability of SMS by 21 hours per week...a equivalent cost saving in computer time for NASA will amount to \$5 million per year."

TIME REDUCED TO PRODUCE SMS
BACKUP TAPES;
DEVELOPMENT TIME INCREASED
"Time now spent on producing backup or secure tapes...a 70 percent time reduction."

SINGER-LINK REDUCES JSC CIRCUIT
BOARD MAINTENANCE COSTS
"...have reduced cost of digital circuit board repairs...saving NASA an estimated \$96,000 during the past two years."

SPAR AEROSPACE LTD. - PRODUCTIVITY IMPROVEMENT AND QUALITY ENHANCEMENT PROCESSES

Spar is a Canadian Corporation with five divisions in Canada and two in the U.S. (California) covering the space, communications, aviation and defense market sectors. The divisions involved with space related products produce remote manipulator systems, spacecraft and flight and ground based communications systems.

The process was formally started by the President and Chief Operating Officer with a commitment to improve both productivity and quality. The process is led at the Corporate level by the Productivity and Quality Councils which include each division and are chaired by the President. Each division has formal improvement plans which form an integral part of the Strategic Plans.

The unit directly contracting with NASA is the Remote Manipulator Systems Division (RMSD) which has produced a comprehensive range of flight hardware including the Space Shuttle Remote Manipulator (Canadarm); the division is now the prime contractor for the Canadian contribution to the Space Station program.

RMSD has a mature PIQE program which is based on the principle of tapping the full potential of all employees through a participative process to identify better ways to do things. At present approximately 25% of the division have participated directly in working groups to action improvement initiatives.

To date this process has produced some excellent results leading to increased development of CAD, CAE, computer networking, reductions in quality costs and major improvements in communications.

As part of a recognition program the President has established an annual award for improvement. The picture below shows the 1985 award being presented to RMSD.

**Sperry Aerospace & Marine Group
Productivity Improvement, Quality Awareness Program**

Coordinator: J.R. Hohimar R31B1
Sperry Aerospace & Marine Group
P.O. Box 21111
Phoenix, Arizona 85036

Phone (602) 869-2618

Sperry Aerospace & Marine Group Space Shuttle/Space Station Productivity-Quality Innovation (SSS-PQI) program is designed to encourage all employees assigned to the Space Shuttle and Space Station program teams to be highly productive and quality conscious. The major elements of the SSS-PQI program include:

- Communications
- Training
- Motivation and
- Mechanization.

A wide variety of communication methods and approaches are being utilized in support of the stated "open door" policy which allows employees access to any level of management, should they feel appropriate actions are not being taken at the lower level. Employees are kept advised of company and program activities and status through a company paper, Space Systems Updates, Quality Reports, functional group newsletters and Leader's Digest. Communications relating more directly to a specific subject, process or improvement is carried out in employee/management involvement groups called Round Tables. These sessions involve workers from a given area with their supervision and a facilitator to discuss those things that seem to hinder performance in the person's day-to-day work environment.

Sperry Aerospace & Marine Group considers training one of the major contributors to productivity. In-house basic skill classroom sessions and hands-on operations are used as part of the learning process. Instructional material is taken directly from the operational and procedural manuals and specifications that will be used after training and certification is completed. The SSS-PQI program makes available and encourages the employee's participation in outside educational courses to provide advanced skills or credit toward a degree. Fees for tuition and books is reimbursed 100%.

Activities designed to promote motivation within the program work group center around providing recognition and rewards for outstanding performance, achievements and ideas that significantly improve productivity. Publicity in the form of posters and pictures are used in the company newspaper and bulletin boards. Achievements of exceptional merit are singled out for special emphasis during a presentation by top Program Management personnel. Breakfast and luncheon meetings or social gatherings are arranged for group achievements. Also, part of the employee motivational process is the presentation of 13 two hour sessions directed at self improvement. Each of these sessions consists of a one hour video presentation and one hour group discussion lead by a trained facilitator. The concepts presented cover the person's relationship with others and the work environment. It provides specific techniques for improving one's self image, morale, attitude and personal goals.

In the SSS-PQI program, special emphasis is being placed on white collar or professional level productivity, which traditionally, has been hard to quantify. In this activity the major element or "product" is the effective processing of data and communicating ideas. Since the major contributor in this area in recent years is the computer, Sperry's program concentrates heavily on the utilization of Personal Computers (PC's) to perform a great variety of tasks that once were done manually. Key to the full utilization of the human/computer relationship is "ease of use", (User Friendly Environment). This has been addressed by application of comprehensive help functions, prompting menus, self-teaching techniques, convenient access to data and non-destructive attributes in the MAPPER[®] system. Additionally, to be most effective, the system must be utilized by the greatest possible number of individuals and provide the necessary interconnections between individuals and locations which need to interchange data. Accessibility to common data bases and application directories are being provided for this purpose. The largest future gains will come with expansion of the system network to include remote locations to facilitate rapid (real time) transmittal of data to all points simultaneously. Common application will facilitate learning and immediate comprehension without the need to translate into other formats, while maintaining flexibility in terms of data presentations and report content.

MAPPER is a registered trademark of the Sperry Corporation.

Sterling Software, Federal Systems
Hilma Mortell
Vice President and General Manager
Systems and Scientific Division
1121 San Antonio Road
Palo Alto, CA 94303 (415)964-6400



**STERLING
SOFTWARE**

Inspection Team Meeting

Sterling Software's Federal Systems group provides software support services to Ames Research Center (ARC) through several contracts encompassing nearly 300 computer specialists and scientists. We have long been committed to using proven QA techniques and to increasing programmer productivity. Two of our most effective methods are the use of Inspections for QA, and the development of a software library, Softlib, to encourage software reuse.

Inspections

Software Inspections are formal technical review procedures held at key points during software development for the purpose of detecting errors. The Inspections procedure developed at IBM was shown experimentally to produce approximately a 23% gain in productivity. Inspections were adapted for ARC by Sterling Software in 1979, for use with the Standardized Wind Tunnel System (SWTS) and other projects. Inspections are used to review every step of software development, from design through code, tests, and modifications. The Inspection team consists of the author, moderator, reader, and inspectors. Tools used in the procedure include: Standards for preparing designs and code; Entrance Criteria specifying the material to be inspected; Checklists of common problems; and Exit Criteria defining what needs to be done. Statistics are entered into a database describing time spent on the Inspection and number of errors detected per thousand lines of code (LOC). Informal comparison of SWTS software reviewed with structured walkthroughs vs. Inspections indicated that the Inspected version had 35-60% less debug and test time and 40% fewer post-release problems. Experience with over 250 Inspections indicates that Inspections implemented prior to unit test detect over 90% of software's lifetime problems. Inspections performed earlier in the life cycle of a task (eg, at the design phase) are the most effective in preventing future problems.

Softlib

Softlib is a central online database of information about reusable software available at ARC. It was proposed by Sterling in 1981 as a way to increase programmer productivity. Sterling programmers are required to consult Softlib for relevant reusable software before beginning projects, and also to submit potentially reusable code or designs. They report monthly how much software was reused. Softlib contains a description of each of over 600 entries including many scientific and mathematical routines, and is accessible using an online interactive search program. Sterling also manages the NASA Bulletin Board System, which contains packages for microcomputers. As a result of the publicity concerning these facilities, software reuse by Sterling programmers (not to mention other Ames personnel) is considerable and increasing. In the last two years, over 440,000 LOC were reported reused. Based on industry wide statistics projecting software development costs, it is estimated that software reuse stimulated by Softlib has saved ARC at least \$2,000,000 in the last two years.

Sundstrand Missile & Space Power Systems

Advanced Technology Group
Sundstrand Corporation



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Sundstrand Aviation Operations initiated a comprehensive long-term quality improvement project early in 1984. It was termed "Yield Enhancement" and was initiated throughout our operations organization. Any successful Yield Enhancement effort centers on making these philosophies an intricate part of the way day-to-day operations are accomplished at all levels. Key indicators of success are as follows:

1. Any effort to be successful must be organization-wide and lead from the top whether strategic or at the local unit level. Top management provides the vision and leadership to show the way.
2. Management and employees must be informed about yield enhancement philosophies to promote understanding. Inherent in this education is training to further develop skills at carrying out these philosophies and a high level of effective two-way communications.
3. Defined goals provide the challenge to move toward obtaining the highest levels of quality and productivity and the feedback necessary on results.
4. Viable award and recognition efforts must be in place to recognize individual and group efforts at all levels to reinforce the whole process.
5. Continued use of up-to-date technologies or processes is a must to increase effectiveness and efficiency of yield enhancement operations. This carries with it the mandate to keep up with the latest information available.
6. Accurate and relevant measurements must be identified and utilized to give meaningful data to operate from and to give effective results. This means that ongoing assessment is imperative.
7. The cornerstone of all yield enhancement efforts is employee participation. Without employee involvement and commitment at all levels, all the rest of these items mentioned before are for naught. Without this element, yield enhancement philosophies will never become an integral part of the way we do business.

SYSTEM DEVELOPMENT CORPORATION'S PRODUCTIVITY/QUALITY IMPROVEMENT PROCESS

Contact: Dr. Dean R. Lee (703)847-3507

In the words of our President and CEO, Frederick F. Jenny, "SDC's commitment to quality and productivity is our major discriminator in the marketplace." With the diversity of projects within SDC, we require a process that is standard in structure throughout the corporation and yet versatile enough to be adapted to the unique characteristics of each Group and project within each Group. A Corporate Productivity/Quality Improvement Team meets quarterly to address this objective through activities such as reviewing the Corporate Quality Assurance Manual for needed revisions.

Early in 1985, the Corporate Team identified the need for quality prevention measures and introduced the Phase Review process. To improve program performance and to ensure that research and development investments complement its strategic plan, SDC plans and manages new products using the Phase Review system. Phase Review facilitates concerted efforts of all organizations--particularly Engineering, Manufacturing, Quality, Marketing, Field Support, Procurement, Distribution and Finance--in announcing, selling and delivering products to SDC's customers.

Quality and Productivity initiatives have been implemented throughout all of SDC. In the manufacturing area quality system training and productivity initiative programs have been a major thrust this past year. Significant rewards in defect recognition and prevention, responsibility for quality and team communication have resulted from the training and application of "Juran on Quality Improvement," and the "Mil-Q-9858A Quality Program." Nine manufacturing departments have collectively developed over 30 monthly productivity measurement indicators with 30% goals for improvement. Among these measurements are actual versus expected energy consumption, audit performance, inspection efficiency, customer reject rates, emergency drawing changes, and the number of excellence awards given.

In our services business area the 14-step process developed by quality advocate Phillip Crosby has been adapted to a 12-step process and supplemented with resources such as the Oregon Objectives Matrix. The matrix has proven to be a valuable management tool since it focuses attention on major indices critical to the success of the operation; it is a tool for setting goals and monitoring the effects of improvement initiatives; and it is versatile enough to use in any environment and at any level and the data can be "folded up" to higher and higher levels from the mailroom to the boardroom.

A major emphasis throughout the Corporation is employee involvement and recognition. SDC's Quality and productivity organization is actively influencing all departments to monitor the quality and effectiveness for the work in which they have responsibility and control and which impacts the future of SDC.

PRODUCTIVITY HIGHLIGHTS

TECHNOLOGY INCORPORATED
Life Sciences Division
Houston, Texas

Mr. Brian Bounds
Quality and Productivity Representative
17625 El Camino Real, Suite 311
Houston, Texas 77058

Technology Incorporated is heavily involved with greatly diversified Life Sciences research at the NASA/Lyndon B. Johnson Space Center. The productivity perspective is to yield higher quality science programs in shorter time frames. This perspective applied to ground laboratory research, space-flight research and technology development. Since scientific accomplishments are dependent upon multidisciplinary groups, e.g., researchers, engineers, laboratory technologists, data analysts, the NASA/Technology Incorporated team implemented an aggressive milestone (goal)-oriented scheduling approach and established self sufficient functional research management in opposition to matrix management. This methodology, together with adding engineering modifications to commercially available instrumentation, reduced the ground/flight research time cycle by factors of 2 and 3. To these actions was applied the widespread use of personal computers. All personnel were encouraged to utilize word processing programs for routine communications within laboratories. The benefits of this practice were enhanced by linking the PC's to a central mainframe processor. This enabled the transmittal of data and activity schedules to the associated researchers. While the procedure presented research information to the investigators very quickly, it also decreased the occurrence of data and inadvertent processing errors. These decreases occurred because the data were rapidly available in a form that permits relatively easy review, verification and revision.



TELEDYNE BROWN ENGINEERING

Ian Alexandre, Manager of Product Assurance
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(205) 544-6317

Teledyne Brown Engineering is the shuttle Payload Mission Integration Contract (PMIC) contractor and the Pressurants and Propellants contractor at MSFC. We are members of the Contractors Productivity Council and supporters of the NASA Productivity Improvement and Quality Enhancement (PIQE) program.

For 1985 and continuing through the first quarter of 1986, our primary PIQE accomplishment has been the automation of our PMIC management, engineering, procurement and manufacturing systems.

Our word processing capability has been expanded by the addition of five STAR graphics workstations to our word processing center. We have also installed Ethernet on the Xerox 860 and STAR systems, creating a total word processing system. All secretaries have at least memory typewriters.

We have added 20 IBM-PCATs, 16 MacIntosh computers and provided formal training for 168 personnel in computer literacy. We have installed an ARTEMIS system for project management and scheduling. We are developing, implementing and maintaining the Payload Management Information System (PMIS), which will be used to manage all the information required in the life cycle of a payload.

In 1985, we implemented a production control system for hardware deliverables. This system is supported by a standard parts inventory system and a computerized route sheet system. We also implemented a task management system for the tracking of all mission activities.

We installed two Intergraph CAD workstations and trained six personnel. We also purchased an Auto Cad drafting package for the IBM-PCAT, as a result of our on-going software package review.

As we secondary achievement, we have implemented an employee suggestion system. Since December, 1985 we have received 46 suggestions and have made two awards. Our first award-winning suggestion significantly reduced the data entry time for thermal timeline analysis of the shuttle payload experiments, utilizing a personal computer.

Teledyne Brown Engineering has a commitment to the PIQE process and has demonstrated support through our automation and participative management achievements.

TRW SPACE AND TECHNOLOGY GROUP

SUMMARY OF SIGNIFICANT ACTIVITIES TO IMPROVE PRODUCTIVITY AND QUALITY

TRW has integrated into its management structure the fundamental objective of achieving superior performance with special emphasis on high-quality products and services. TRW management meets this objective by aggressively pursuing goals: 1. To provide high-quality and reliable products and services at competitive prices, and 2. to maximize our productivity at all levels through the proper use of capital, material, technology and people. These goals are the foundation of our productivity improvement and quality enhancement efforts.

Listed are key activities and programs used by spacecraft project and functional units to achieve improvements in productivity and quality.

ENGINEERING AND TEST AUTOMATION PROGRAMS

- o Integrated Spacecraft Automated Test System
- o Integrated Spacecraft Data Exchange System
- o Engineering work stations and computational center

COST EFFECTIVENESS PROGRAM FOR COMPETITIVE ADVANTAGE

- o Streamlining and reducing organizational levels
- o Pay for performance program
- o Overhead reduction program
- o Value added chain modifications and schedule span time reduction for spacecraft design, manufacture, assembly and test
- o Improved utilization of spacecraft assembly, test and inspection crews

QUALITY INITIATIVES

- o Corrective Action process
- o Scrap, Rework and Repair
- o Design quality
- o Spacecraft testing processes
- o Contractor/supplier relationships

EMPLOYEE INVOLVEMENT PROGRAMS

- o Employee Suggestion Program
- o Employee Circles and Involvement Teams
- o Awards and recognitions including sharing cost savings (only on Gamma Ray Observatory Project)

MANAGEMENT AND COMMUNICATION

- o Simplified performance measurement system
- o Automated Critical Path Schedule Network system
- o Computerized customer and sub-contractor networks
- o Video Teleconferencing system

IMPROVED PROCUREMENT CYCLE

- o Accelerated change negotiations
- o Automation of preparation and submittal of contractor reports
- o Contract Productivity Incentive Clause negotiated with NASA

UNIQUE ELECTRONICS, INC.

We at Unique are totally committed to Quality. In order to achieve this, we have taken the responsibility down to the person who does the job. The attitude of all has greatly improved and we are making progress in taking steps to reduce errors and maintain schedules. The old saying DO IT RIGHT THE FIRST TIME is our goal. Our Quality group has been a great asset in record keeping and publishing a weekly report of all defects in order to highlight problem areas. Then action is taken to correct any process problems, materials or added training.

In order to keep controls on schedules for customer deliveries, we have implemented a daily schedule review with department supervisors in order to insure production problems are quickly identified. Along with this, we are now placing all orders on computer in order to maintain more accurate information for material requirements and long range planning and scheduling. This will enable management to make better and faster decisions in order to meet our customer requirements.



UNIQUE ELECTRONICS, INC.

1320 26th STREET ORLANDO, FLORIDA 32805 PHONE (305)422-3051



From our 1919 beginning, Hamilton Standard has been a world leader in propellers and controls including a diversified product line embracing life support systems for space applications to sophisticated support equipment for ship board application. We have been able to stay competitive because we have quality people producing top quality parts for top quality customers.

Recognizing that the highest quality parts are produced by dedicated people, we have developed a culture that has been very successful in (1) rewarding our people's achievements, (2) nurturing and developing their talents in an open environment and (3) bringing these talents to bear to solve the problems brought on by the ever more demanding marketplace.

The key initiatives include:

- **UNITED TECHNOLOGIES SPECIAL AWARDS PROGRAM** - Over \$546,000 of Special Awards have been presented to more than 300 Hamilton Standard employees since 1983 covering extraordinary achievement in customer service, contribution to the community, design and management effectiveness and other outstanding efforts.
- **MERIT AWARD PROGRAM** - Over 4,100 merit awards totaling \$500,000 have been presented to employees for productivity improvement in production and administration.
- **EMPLOYEE MOTIVATIONAL AWARDS** - Eighty (80) Motivational Awards have been given to employees of our Space & Sea Systems Department for special achievements in improving productivity and quality of our products and services.
- **QUARTERLY MANAGEMENT REPORTS** - Management presents a quarterly report and forecast of our business, technical and production progress (to all of our employees in Space & Sea Systems).
- **SELF-AUDIT PROGRAM** - Performance of 40 audits of procedures to identify problem areas and to retrain manufacturing, quality and engineering has resulted in a reduction of discrepancies per audit from 4.5 to 3.0. This has also helped reduce our material review action from 16 to 3 per 1,000 hours of assembly and test.
- **SUPPLIER QUALITY ASSURANCE** - A program of vendor review and performance measurement has improved lot acceptance from 85% to 90% over the last year.
- **COMPUTER CONTROLLED SYSTEMS** - Resulted in over \$300,000 yearly savings for calibration and testing electrical equipment, valves and sensors, structural testing and data acquisition.
- **COMMUNICATION COUNCIL** - A council of employee peers addresses concerns raised by employees and focus management action to correct problems concerning work environment, personnel issues and job-related problems. Last year, responded to 80 items within Space & Sea Systems Department.
- **CAD/AM** - All flight hardware drawings are now being prepared on Computer Augmented Design and Manufacturing (CADAM). Drawing errors are reduced because of the accuracy achieved and the ability to readily perform many comprehensive drawing studies. In 1986, the reduction in Engineering Changes due to errors is 30%.

SUMMARY

On April 7, 1986 Division President Dick Gamble sent each of his fellow employees a letter reviewing our past achievements and dedicating our efforts to be the market leader in all we do by defining a standard of excellence of doing the right things right the first time, having respect for our customers and each other and reaching for increasingly more demanding goals to provide growth and opportunity for all of us. Our Performance Improvement Program is underway with renewed spirit and team work along with the above incentives. This comprehensive plan reaches every function and every employee, establishing goals and records with a top down management system that provides rewards consistent with achieving our vision of excellence.

USBI-Booster Production Company

Focal Point Individual:

Mr. Walter E. Hall
Manager, Productivity
P.O. Box 21212
Kennedy Space Center, Fl 32899

**Automated Solid Rocket Booster Refurbishment**

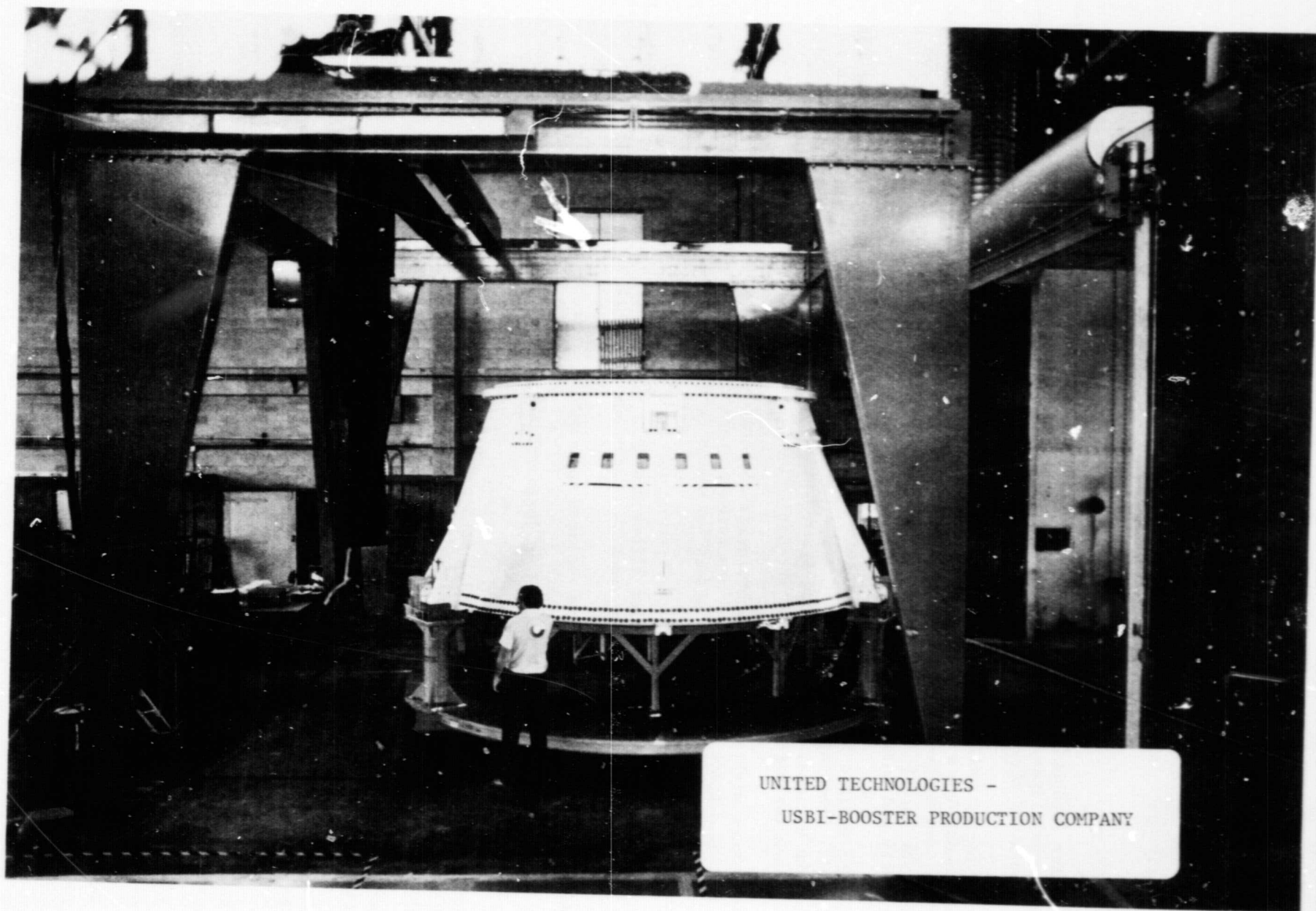
USBI-Booster Production Co. is currently working on NASA contracts awarded and administered by the Marshall Space Flight Center. They cover the manufacture, assembly, checkout and refurbishment of the Solid Rocket Booster's non-motor segments at the Kennedy Space Center.

Another contract calls for the construction of a new SRB Assembly and Refurbishment Facility at the Kennedy Space Center, Fla. Within this facility, new insulation will be applied, electrical and mechanical systems installed, parachutes attached and the booster components tested. The latest in robotics, computer control and automated processes will improve productivity and enhance quality.

Four of the world's largest gantry robots have been built to clean and refurbish the SRB components. Standing nearly 30 feet high, the robots are the first of their type to be used by the National Aeronautics and Space Administration (NASA) for refurbishing booster rocket non-motor hardware.

In conjunction with our United Technologies corporate resources we are developing and implementing a number of automated processes to replace present manual operations or those that present a significant safety hazard to personnel. These processes are briefly summarized below:

1. Use of an overhead gantry robot allows a single robot unit to work inside or outside the frustum and aft skirt without requiring hazardous structure lifting operations.
2. Manual sanding and cleaning is replaced with automated processes.
3. A Vision System video camera and an image processing computer automates the inspection of structure surfaces.
4. Marshall Sprayable Ablative (MSA) is applied using a robot mounted spray gun. The Vision System runs vendor developed custom software to measure MSA wet thickness during spray operations.
5. Robotic application of Insta-Foam inside frustums and aft skirts will remove personnel from undesirable working conditions and a potentially toxic environment.
6. Automatic inspection of Thermal Protection System (TPS) application for flaws such as cracks and voids is performed using the Vision System and flaw detection image processing software.
7. Robotic manipulation of an automatic spray gun for application of Hypalon topcoat over the finished TPS is used.
8. Automated inspection of the topcoat for excessive runs and sags, incomplete coverage or other flaws completes the TPS application processing.
9. Removal of applied TPS material after launch and recovery is accomplished with a dual pump system that forces water at supersonic speeds through a robot manipulated nozzle to strip applied materials from hardware rotating on a turntable.



UNITED TECHNOLOGIES -
USBI-BOOSTER PRODUCTION COMPANY



**Westinghouse
Electric Corporation**

Defense Group

**WESTINGHOUSE DEFENSE AND ELECTRONICS CENTER
PRODUCTIVITY IMPROVEMENT**

In 1981, the Westinghouse Electric Corporation was one of the first companies to establish a corporate wide Productivity and Quality Center as well as establish strategic goals and objectives to be met by all groups and divisions. The Westinghouse Defense and Electronics Center (D&EC) has required each operating division to design, develop and implement an overall Productivity and Quality Improvement Plan that integrates with the corporate strategic goals and objectives. Westinghouse is continuing to create a work environment in which employees can further improve their job performance. Employees are being given the tools to be more effective/efficient via technology, systems, facilities and training.

Quality improvement is the key strategy for productivity improvement. Quality is emphasized in every aspect of the work process, including that of our suppliers and subcontractors. By literally, "Doing the Right Things Right the First Time", we have substantial potential for improving the satisfaction of our customers. Design for producibility begins prior to Full Scale Development (FSD) and is the key to cost effective FSD in production programs.

Quality and Productivity Improvement is a way of life at D&EC. We encourage the participation and involvement of all D&EC personnel, hourly and salary, professional and management, in meeting our total Quality Productivity Improvement objectives. To this end, we utilize a team of approach that cuts across interdisciplinary functions to remove the traditional barriers to change. Results to date have been significant, but we still have a long way to go. For the past five years, D&EC has achieved a cumulative improvement in net value added per employee of 41.8%. Our strategy has been directed towards finding the optimum balance between people, systems and technology, consistent with improving quality and productivity, for our ever increasingly complex product line. Similarly, we have made a significant improvement in reducing the cost of purchased material. We established a Material Acquisition Center (MAC) in 1982 to centralize our material planning, purchasing, receiving, vendor evaluation and component prep and kitting activities. In addition, we have been consolidating our vendor base, installing state of the art Material Requirements Planning (MRP) and Purchasing Systems, to consolidate time phased requirements generation and shorten cycle time between requirement and component delivery, as well as focusing on cost effective strategic sourcing.

Capital Facilities Investment has increased 237% since 1979. This is in keeping with the goal of modernizing our facilities as well as introducing new product/process technology required by our complex defense electronic system requirements. In the last 5 years, major investments have been made in expanding our advanced technology laboratories for the design and manufacture of next generation electronics and the creation of an Electronic Assembly Plant (EAP) and MAC. These specialized process satellite plants incorporate the latest state-of-the-art process automation, integrated material handling systems, real time computer control and human resource concepts and philosophies. Westinghouse is working towards "automating" the manufacturing process from parts fabrication to assembly, test and inspection; including material controls and handling.

Westinghouse is emphasizing producibility through the use of standard product designs and manufacturing processes, multi-functional involvement in the design process, and the use of statistical techniques. Westinghouse is developing integrated computer systems that truly automate and standardize the manufacturing process as well as incorporate process control features to automatically verify product quality parameters.

Westinghouse D&EC has pioneered a major Industrial Modernization Incentives Program (IMIP) with Electronics Systems Division at Hanscom Air Force Base in July of 1981 to develop and implement advanced technologies for the manufacture, test and inspection of digital, analog and flat pack printed wiring assemblies. This Get PRICE (Productivity Realized Through Incentivizing Contractor Efficiency) contract has been the standard for multi-customer, multi-IMIP implementation. We have already saved the Department of Defense \$33.9 million by realizing a shared savings incentive payment of over \$6 million to date. The savings realized from manufacturing printed wiring assemblies at the Electronic Assembly Plant (EAP) is in excess of 40% against the pre-technology modernization base line.

"Doing the Right Things Right the First Time" underlies the overall productivity and quality improvement strategy. By putting our premier emphasis on quality when designing the product and concurrently designing the manufacturing process that produces quality and then emphasize quality with our suppliers and employees, one can simultaneously improve productivity.

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